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Environmental factors affecting the distribution of native and invasive aquatic plants in the Atchafalaya River Basin, Louisiana, U.S.A.

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ENVIRONMENTAL FACTORS AFFECTING THE DISTRIBUTION OF NATIVE AND INVASIVE AQUATIC PLANTS IN THE ATCHAFALAYA RIVER BASIN, LOUISIANA, U.S.A.

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ABSTRACT

Over the last century, the aquatic macrophyte community of the Atchafalaya River Basin (ARB) has become increasingly dominated by invasive species. I used digital photography and GIS software to determine ARB macrophyte community composition by measuring percent cover of each plant species within five 0.25-m^2 quadrats sampled from 108 sites in 2005 and 103 sites in 2006. Macrophyte community data and measurements of soil and water physicochemistry at each site were used to investigate environmental associations of the macrophytes inhabiting bayou, lake, excavated canal, and swamp habitats. Analyses indicated substantial differences in physicochemical conditions among habitats, but none of the 20 macrophyte species collected during the study exhibited consistent preferences for specific habitat types. Percent coverage of invasive plants was greater than native plants across all habitat types in both years, with invasive plant richness increasing in 2006 with the arrival of giant salvinia (*Salvinia molesta*). Common salvinia (*Salvinia minima*) appeared to have the greatest impact on the native plants, exhibiting inverse abundance relationships with six of fourteen species (43%). Comparisons of slopes from areal coverage – dry weight regressions based on macrophytes that were photographed, collected, and dried from quadrats sampled at 26 sites in 2006 suggested that invasive species accumulated more biomass per unit area than ecologically similar native taxa. In both years, terrestrial plants were observed in association with floating mats of other macrophyte species, apparently taking advantage of the mats as "terrestrial" substrate. Submerged plants exhibited few significant differences in abundance among the four habitats, although they

did tend to occur where floating plants were not abundant. There were few physicochemical differences among vegetated and non-vegetated sites for native or invasive plants, although pH was lower at vegetated sites (versus non-vegetated) for both native (2005) and invasive (2005 and 2006) plants. Canonical discriminate function analysis revealed substantial changes in plant community composition and physicochemistry between the two years at approximately 25% of the study locations. These changes highlight the dynamic nature of the littoral zone and the multiplicity of deterministic and stochastic factors that likely affect the composition of the resident macrophyte community in the ARB.

INTRODUCTION

The Atchafalaya River Basin (ARB) is a unique floodplain swamp ecosystem in the southeastern United States that is characterized by a diversity of aquatic habitats, including the main river channel, numerous lakes, backwater swamps, and interlinking canals and bayous. Many activities take place within the ARB, including recreational and commercial fisheries, oil and natural gas exploration, tourism, hunting, timber extraction, and navigation inland from the Gulf of Mexico. The ARB is home to a vast array of flora and fauna, including nine endangered or threatened wildlife species and over 100 shellfish and finfish species. The ARB also serves as important wintering ground to more than 170 species of birds that migrate via the Mississippi Flyway (USGS 2001).

Numerous anthropogenic changes in the ARB have disrupted the hydrology of this floodplain ecosystem. Channel training activities have closed many of the distributaries that formerly conveyed water from the mainstem river to the floodplain. In addition, petroleum and timber companies have created a network of pipeline and navigational canals to support their operations, and spoil banks from these canal excavations have disrupted water circulation and the flooding and draining of backwater swamps during the spring flood pulse (Sabo et al. 1999 a, b). Disrupted flow patterns combined with high sediment inputs from the Mississippi River have also significantly altered the ARB ecology and contributed to the loss of many floodplain habitats.

Many of these ecosystem perturbations appear to have increased the susceptibility of the ARB to invasion by non-native aquatic species during the last century. Exotic

species have caused significant ecosystem changes worldwide, and are major threats to nearly 80% of endangered species across the globe (Armstrong 1995). The ARB is extremely vulnerable to invasion by non-native aquatic fauna due to its subtropical climate (Davidson et al. 1997), as well as annual levee-to-levee flooding that provides access to aquatic habitats throughout the floodplain. Over the last three decades, exotic macrophytes have become particularly problematic, and their impacts on native aquatic plants, water circulation, water quality, and fisheries production are of substantial concern to Louisiana's natural resource agencies. Non-native aquatic macrophytes that are particularly problematic in the ARB include water hyacinth (*Eichhornia crassipes*), hydrilla (*Hydrilla verticillata*), common salvinia (*Salvinia minima*), and more recently, giant salvinia (*Salvinia molesta*). Many of these invasive macrophytes have become dominant species in the aquatic plant community, and all are characterized by excessive growth, tolerance of poor water quality conditions, and the formation of dense canopies at the water's surface. Due to their aggressive growth habits, they appear to display a significant competitive advantage over native macrophytes, which has resulted in a decline in native macrophyte richness and continued impacts on aquatic system function.

Water hyacinth is an exotic floating macrophyte native to South America that was introduced to Louisiana in the 1880's through the horticulture trade as an ornamental pond plant. To date it has invaded 15 states in the continental U.S., as well as Hawaii, Puerto Rico, and the Virgin Islands (USDA NRCS 2006). The plant has been documented in more than 50 countries and has been named one of the worst weeds in the world (Holm et al. 1977). Water hyacinth's ability to double its population size in as little as 6-18 days (Mitchell 1976) poses major problems in non-native habitats, where it

often forms extensive colonies of interwoven mats that clog waterways, shade-out native submersed macrophytes, degrade water quality, obstruct navigation, and prevent swimming and fishing. Water hyacinth has also been reported to intensify mosquito problems by hindering application of insecticide, interfering with predator foraging success, and impeding water circulation (SeaBrook 1962).

Hydrilla is a submerged aquatic species native to southeast Asia that was introduced to Florida in the 1950's as an aquarium plant (Florida Department of Environmental Protection 2005). Since its introduction, hydrilla has aggressively invaded the eastern seaboard states, as well as California, Arizona, and Washington, and has been cited as being second only to water hyacinth as one of the worst aquatic pest plants in the world (Soerjani 1985). Hydrilla forms dense stands of very long stems that branch profusely at the water's surface (Langeland 1990) and usually shade out phytoplankton and other submerged macrophytes. Once hydrilla becomes established, dense littoral stands make boat navigation difficult and recreational activities such as swimming impossible. Hydrilla is very prolific and can regenerate from small cuttings; a single shoot can produce as many as 6,000 new tubers per square meter (Sutton et al. 1992).

Common salvinia is a tropical aquatic floating fern native to South and Central America, and is another invasive species that exhibits high rates of reproduction and tolerance to a wide range of temperatures (Olguin et al. 2002). It was first documented in Florida in 1928 (Small 1931), with the initial wild introduction resulting from flooding of ornamental garden ponds and dispersal of the plant into natural water bodies. Common salvinia was first documented in Louisiana in 1980 (Landry 1981) and now dominates the

macrophyte community in many waterways in the ARB. Common salvinia is considered a problematic species in Louisiana where its rapid growth can form dense surface mats (Jacono et al. 2001) that shade the water column and any underlying vegetation.

Giant salvinia, a native to southeastern Brazil (Forno et al. 1979), is a floating aquatic fern that has been introduced, typically as an aquarium or ornamental water garden plant, to more than 20 countries (Room et al. 1981). Giant salvinia was first reported in the United States in South Carolina in 1995 (USGS 2004), and was reported in Toledo Bend Reservoir, bordering Texas and Louisiana, in 1998 (USGS 2004). Under favorable natural conditions, giant salvinia is able to double its biomass in a week to ten days (Mitchell et al. 1975). Rapid growth allows giant salvinia to form dense mats that may alter aquatic ecosystem function by displacing native species (Mitchell et al. 1991). Giant salvinia was first reported in the ARB in 2006 (Louisiana Department of Wildlife and Fisheries, personal communication) and was also recorded at various ARB sites during this study.

Alligatorweed (*Alternanthera philoxeroides*), watermilfoil (*Myriophyllum spicatum*), and water lettuce (*Pistia stratiotes*) are also invasive macrophytes found in the ARB. Although these species have proven to be significant nuisances in other parts of the world (Smith et al. 1990; Julien et al. 1995; Gordon 1998), their occurrence in the ARB over the last decade has been sporadic, and none have proven to cause significant ecological, economic, or recreational problems.

Exotic plants can impact the biotic structure and productivity of invaded ecosystems in numerous ways (Gordon 1998), including disruption of nutrient cycling, alterations in pH and water column temperature gradients, and physical obstruction of

lotic and lentic waterways. Aggressive species often displace native taxa, and the monotypic communities formed by exotic plants can exclude natural food sources for herbivorous wildlife (Fields et al. 2003). In addition, invasive macrophytes can significantly alter water quality conditions, reducing dissolved oxygen levels and reducing or eliminating habitat for native fishes and invertebrates that are sensitive to hypoxia. Dense surface canopies prohibit gas exchange between the water's surface and the atmosphere (Caraco et al. 2002), and severely limit sub-surface light and oxygen levels, particularly at night (Colon-Gaud 2003). Reduced photosynthesis by submergent leaves and algae under surface macrophyte mats (McVea et al. 1975; Cataneo et al. 1998) can affect invertebrate community abundance and composition (O'Hara 1967; Hansen et al. 1971; Colon-Gaud et al. 2004), which can be reflected in reduced diet quality among resident fishes (Toft et al. 2003). Dense stands of submerged taxa like hydrilla also reduce water velocities, which can be detrimental to more sensitive native plants that benefit from moderate water flow to improve leaf uptake of nutrients, dissolved inorganic carbon, and oxygen (Smith et al. 1980; Larkum et al. 1989; Stevens et al. 1997). Dead aquatic vegetation may affect fishes by reducing dissolved oxygen (Killgore et al. 2001), sequestering nutrients (Brenner et al. 1999) and similar to fine sediment (Argent et al. 1999), reducing reproduction by smothering or altering spawning habitats (Schneider 1999).

The United States spends millions of dollars annually in losses and damages due to aquatic weeds (Pimentel et al. 2000) and $100 million on management (OTA 1993). Over a 13 year period, Florida alone spent approximately $39 million managing hydrilla in public waters (Schardt 1997), and hydrilla has been estimated to have caused $10

million in recreational losses in just two Florida lakes (Center et al. 1997). In the ARB, Henderson Lake underwent seasonal drawdowns in 1996-1997 and 2000-2001 (40-60% of the bottom exposed) in an effort to reduce hydrilla densities, but low water levels created economic problems for local businesses and recreational fishers, and long-term effects on hydrilla abundance were minimal. The state of Louisiana subsequently spent $1 million to treat the lake with the aquatic herbicide fluridone, and recently (late spring 2006) conducted an additional small drawdown with herbicide treatments, but long-term hydrilla abundance in the lake will likely be extremely problematic.

Limited knowledge of the factors affecting aquatic plant dynamics in the ARB has contributed to the lack of an effective control program for resident invasive plants, and data concerning the factors that determine plant community composition and abundance will provide valuable information for the development of future management strategies. The detrimental effects of invasive aquatic plants on the structure and function of the ARB ecosystem are pervasive, and it is imperative that we understand the ecology of these invaders if we are to reduce the magnitude of exotic macrophyte problems in the ARB.

This study was designed to assess the habitat requirements of ARB aquatic plants to understand the factors responsible for the spatial and temporal variability that is evident in macrophyte community composition and abundance. Specifically, this study addressed the following questions:

1. How abundant are invasive macrophytes in the ARB, and are invasive species impacting the abundance of native aquatic macrophytes?

2. What factors are associated with spatial and temporal patterns in aquatic macrophyte community composition?
3. Based on measured physicochemical characteristics, are there distinct macrophyte habitats within the ARB, and if so, what habitats favor native versus nonnative macrophytes?

METHODS

Study Site

The study location encompassed a 1,100 km^2 portion of the southeastern ARB bounded on the west by the Atchafalaya River and on the east by the Intracoastal Waterway (Figure 1). The study area was chosen to include aquatic habitats that are characteristic of the entire ARB, including natural bayous, pipeline canals, dead end canals, lakes, and backwater swamps. The Atchafalaya River and the Intracoastal Waterways were excluded from the study because of high current velocities and turbidity levels that effectively eliminate establishment of macrophyte beds.

Sampling and Laboratory Methods

I used digital ortho quarter quads (DOQQS; Atlas: The Louisiana Statewide GIS) of the study area along with ArcGis version 9 (ArcMap, Environmental Systems Research Institute, Inc., Redlands, CA) to produce a map of the study location. The distribution mapping software Disease Mapping and Analysis Program (DMAP, version 7.2, Alan Morton, Berkshire, UK) produced a 0.75 kilometer grid of consecutively numbered points on the map. A random number generator (Haahr 1998) was then used to randomly pick 150 potential sample locations. Each location was identified as a manmade canal, bayou, lake, or swamp and was visited once in 2005 and once in 2006 during low river stages after the spring flood pulse had subsided (minimal drainage from the floodplain). Bayou, lake, and swamp locations were considered to be representative of natural habitats, whereas locations in dredged pipeline or navigation canals represented disturbed habitats. Sampling began the first week of August and ended in October when the plants began to senesce. Each location included five sampling points, including a

Figure 1. The Atchafalaya River Basin, Louisiana and study sites

central point (the original point marked by DMAP), and four points located 5 m away radiating at cardinal angels. No point was closer than 0.5 m to the shore to exclude terrestrial vegetation, and if canals were too narrow to allow for the 5-m distance, the greatest distance available was used.

At the center point within each location, temperature, pH, salinity, dissolved oxygen, and turbidity was measured 20 cm below the water surface with a Quanta® water quality monitor (Hydrolab, Inc., Austin, TX, USA). A Secchi disc was used to measure water column light penetration, and water velocity was measured with a FlowTracker® Handheld Acoustic Doppler Velocimeter (SonTek, YSI, Inc., Yellow Springs, OH, USA). Depth measurements were taken at all five points to estimate average depth for each location.

Water samples were collected 10 cm below the surface in polyethylene containers at the shallowest and deepest points to assess potassium, phosphorus (orthophosphate), carbon (total, total organic, inorganic, dissolved organic), and total nitrogen concentrations in the water. In 2006, water sample assessment also included calcium concentrations. Water samples were kept on ice in the field and refrigerated (4°C) after returning to the laboratory. Potassium and phosphorus samples were analyzed with a DR/2500 Spectrophotometer (Hach Company, Inc., Loveland, CO, USA) via Hach Method 8049 (Tetraphenylborate Method) and Hach Method 8048 (EPA Approved). Carbon and nitrogen samples were analyzed with a Shimadzu TOC-V Combustion Analyzer (Shimadzu North America, Columbia, MD, USA) via Method 5310.B and Method 4500.N (American Public Health Association, 1998), and calcium samples were analyzed with a Perkin-Elmer Flame Atomic Absorption Spectrophotometer (Model

3100, Thornhill, ON, Canada) via method 3111B (American Public Health Association, 1998). Sediment samples were also collected at the water sample points with an Eckman dredge. Sediment samples were placed in polyethylene containers and kept on ice in the field and refrigerated (4°C) after returning to the laboratory. Sediment samples were taken to the LSU AgCenter Soil and Plant Analysis Lab, where they were oven dried (103°C) and analyzed for pH, percent organic matter, and concentrations of calcium, phosphorus, and potassium. In 2006, soil samples were also assessed for concentrations of carbon and nitrogen.

In order to more accurately quantify aquatic plant community composition, I developed a new method to assess macrophyte community composition at each sampling point based on digital photographs of plants within a 0.25 m^2 floating PVC quadrat (Figure 2). Percent coverage of each plant species within the quadrat was determined by digitizing each photograph with ArcGis version 9 (ArcMap, Environmental Systems Research Institute, Ind., Redlands, CA, USA). I digitized each photograph by placing a control point in each corner of the photograph. To give each photograph an area equal to one, every control point was given a coordinate in an x, y plane (i.e. 1, 1; 1, 2). After a photograph had coordinates, I then digitized polygons for each individual plant species and determined the percent area coverage of each plant species by summing the area coverage of each of their polygons.

All plants were identified to species (with the exception of *Lemna*, *Cyperus*, and *Potamogeton*) with characters described by Godfrey et al. (1979, 1981). Within 26 selected quadrats sampled in 2006, all individuals of each macrophyte species were collected, bagged, placed on ice, and returned to the laboratory where they were sorted,

rinsed and dried to constant weight. Dry weights for each plant type were then used to estimate total plant biomass (g dry weight) within each quadrat.

Statistical Methods

Because of substantial differences in the temperature regimes, flood pulses (Figure 3), and water levels between 2005 and 2006, I analyzed the data on macrophyte community composition and habitat characteristics separately for each year. Prior to analyses, I log-transformed the percent coverage data for each plant species (percent coverage within each quadrat) to better approximate normality. For the initial analysis,

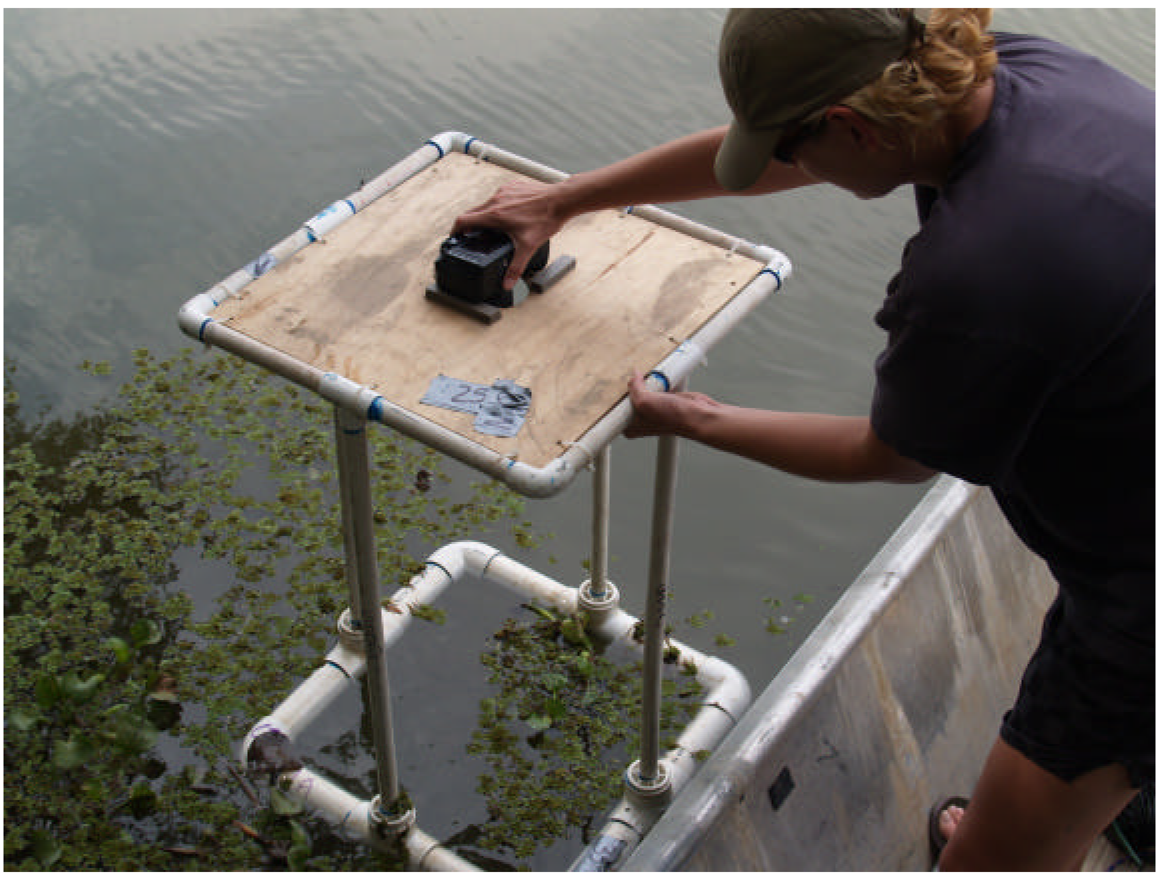

Figure 2. Digital photograph of aquatic macrophytes taken within a 0.25 m^2 floating PVC quadrat

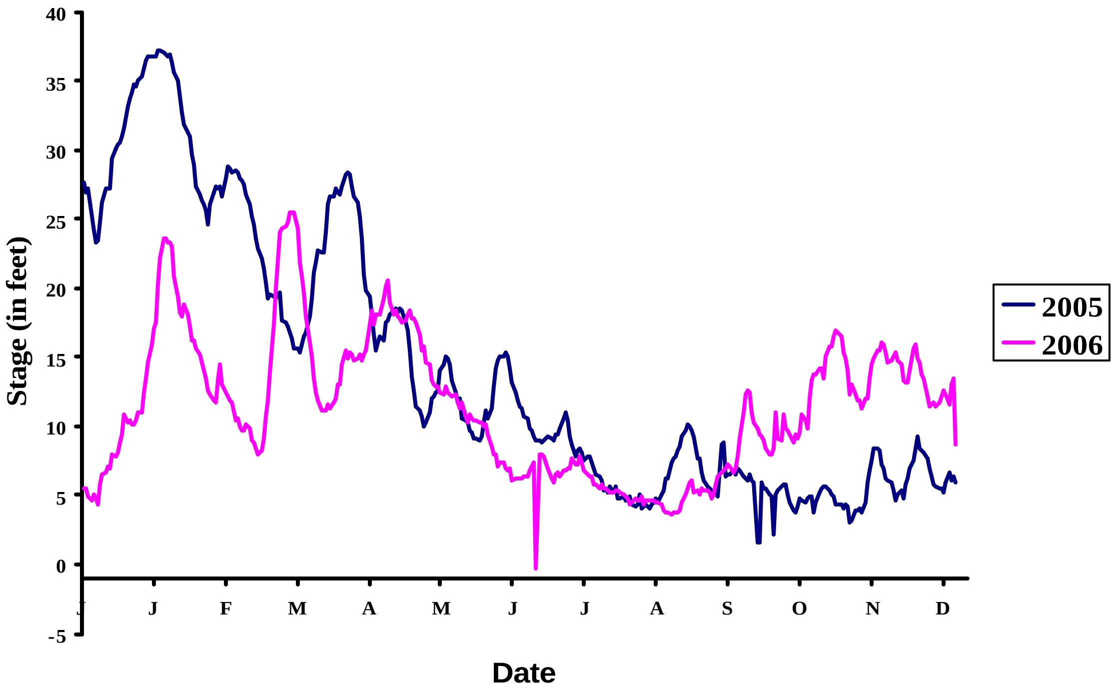

Figure 3. Atchafalaya River stages for 2005 and 2006

I used simple linear regression to determine the relationship between percent coverage within a quadrat versus dried weight so I could estimate the mean biomass of each macrophyte (mg dry wt/m^2) each year. I then used analysis of covariance (ANCOVA) to examine the regression slopes for invasive and native species (of similar growth form) to compare differences in biomass accumulation rates.

I used multivariate analysis of variance (MANOVA) and *a priori* contrasts on each year's data to determine whether there were differences in the physicochemical properties among different habitats. I also performed a MANOVA to assess the effects of physicochemical factors on both native and invasive plant communities, and compared full and reduced models to evaluate which factors were having the greatest effects on the distributions of the different plant taxa.

To determine whether plant-environment interactions resulted in identifiable plant community types in the ARB, I grouped macrophytes based on their native distribution and position in the water column. I then performed a principal component analysis (PCA) with varimax rotation for each year on these data. I retained components for all PCAs if their eigenvalues greater than 1.0, and I focused only on those plant taxa that exhibited correlations of 0.5 with a particular component. I scored each location on each of the retained components, and then used MANOVA to test for differences in scores among the four habitat types.

I used canonical discriminant function analysis (CDFA) to determine whether the plant communities changed within specific locations from year-to-year. I scored the locations based on the first axis produced by CDFA, and then reduced the number of locations for between-year comparisons of plant community composition to those sites exhibiting differences of greater than two units along the CDFA axis. I conducted a paired t-test to examine changes in CDFA score between years at a given location, with a significant change in score interpreted as a significant change in plant community composition. To determine how the locations from the reduced model changed physicochemically, I again performed CDFA on the physicochemical properties of those locations along with the paired t-test to test for significance. Finally, I used logistic regression to compare characteristics of vegetated and non-vegetated locations for the native plant community as a whole, as well as for each invasive species, to assess potential explanations of why plant communities and invasive taxa did or did not inhabit a given location. All statistical procedures were performed with Statistical Analysis System software (SAS, version 9.1.2, Cary, North Carolina, USA).

RESULTS

Plant Collections

During the course of this study, I visited 103 locations twice and 5 locations once, which yielded a total 1,055 quadrats (501 of which contained plants), and 440 water and soil samples. Among the invasive species, common salvinia was particularly abundant (96.8% of quadrats with plants), but water hyacinth (35.5%), hydrilla (18.5%), and alligatorweed (9.5%) were also common. Giant salvinia was first identified in 2006 and occurred at 2.0% of the vegetated sites that I sampled.

In 2005, I sampled 108 locations, including 30 bayou, 18 lake, 52 manmade canal, and 8 swamp habitats. Initially, three water and soil samples were collected at each location, but because of limited variability of these data from the first 18 locations, I subsequently collected only two samples per location, which yielded 234 samples each of water and sediment. There were 278 photographs analyzed from points that yielded detectable macrophyte coverage, which was 52% of 540 (108 locations x 5 points) potential samples; the remaining 262 points yielded no plants. I identified 17 plant taxa in the 2005 samples, five of which were invasive (Table 1). Lake locations exhibited minimal macrophyte coverage relative to the other two habitats, and swamp locations were devoid of native fanwort (*Cabomba carolineana*), coontail (*Ceratophyllum demersum*), pondweeds (*Potamogeton* spp.), and water primrose (*Ludwigia peploides*), which were present in canals and bayous. Common salvinia and water hyacinth were dominant across all habitat types, and only duckweed (*Lemna* spp.) in swamps and frog's bit (*Limnobium spongia*) in manmade canals exhibited percent coverage over 5%.

I sampled 103 locations in 2006, including 28 bayou, 18 lake, 49 canal, and 8 swamp habitats, with five 2005 locations inaccessible because of low water levels. Two water and soil samples were taken at each location, yielding a total of 206 samples each. I took 223 digital photographs out of 515 (103 locations x 5 points) potential samples, with no plants recorded at 292 points. I identified 20 plant species in quadrat samples during 2006, six of which were invasive (Table 1). Lake sites again showed a depauperate macrophyte community relative to the other habitat types, and common salvinia and water hyacinth were still the most dominant taxa across all habitat types, with no other plant exhibiting coverage over 4% in any habitat.

There were sufficient data to generate linear models of dry weight versus percent coverage for 12 of the 20 most abundant species in this study (Table 2); biomass contributions of the other six species were typically negligible at most sites. In 2005, swamp habitats exhibited the highest total biomass of plants per m^2, followed by canals and bayous, with much lower plant abundance observed in lakes. As would be expected from trends in percent coverage, common salvinia and water hyacinth exhibited the highest mean biomass across all habitat types, and accounted for approximately 70.3% (bayous) to 92.9% (lakes) of the biomass of plants at these locations (Table 3). However, other plants made significant contributions to community biomass, including duckweeds in swamps, flatsedges (*Cyperus*. spp.) in manmade canals, and hydrilla in canals and bayous. In 2006, community biomass was once again dominated by common salvinia and water hyacinth, which together accounted for 77.6% (bayous) to 99.5% (lakes) of plant dry weight at sampled locations (Table 3). As in 2005, biomass contributions

Table 1. Percent coverage of macrophytes for the four habitat types of the Atchafalaya River Basin in 2005 and 2006. Data presented are mean percent area coverage within quadrats that contained macrophytes. Standard errors are in parenthesis, and invasive species are indicated by asterisks (*). N= the number of sites sampled within each habitat type, and number of locations where macrophytes were present in each habitat type are indicated under the percent coverage and standard area.

	2005				2006			
Plant species	Canal N=52	Bayou N=30	Lake N=18	Swamp N=8	Canal N=49	Bayou N=28	Lake N=18	Swamp N=8
*Salvinia minima**	33.12 (2.78)	14.69 (2.64)	2.62 (2.04)	30.84 (5.90)	45.19 (3.15)	33.58 (4.95)	10.02 (5.85)	25.35 (7.98)
	48	20	2	8	48	19	6	6
*Eichhornia crassipes**	5.92 (0.82)	8.21 (1.90)	6.48 (6.48)	25.99 (4.88)	4.39 (0.88)	5.94 (1.49)	3.22 (2.40)	3.87 (2.72)
	27	14	1	7	27	11	2	2
Lemna spp.	2.67 (0.76)	1.23 (0.34)	2.23 (2.08)	14.17 (3.65)	0.25 (0.02)	0.22 (0.03)	0.11 (0.04)	0.62 (0.34)
	36	19	2	8	43	18	6	6
Limnobium spongia	5.84 (1.19)	1.09 (0.64)	0.04 (0.03)	2.72 (1.05)	0.06 (0.02)	0.02 (0.01)	0.01 (0.01)	0.24 (0.15)
	24	7	2	4	9	3	1	2
*Hydrilla verticillata**	4.15 (1.25)	4.34 (2.29)	-	0.05 (0.04)	0.87 (0.44)	0.30 (0.17)	-	2.14 (1.16)
	28	11		2	15	5		3
Nelumbo lutea	-	-	-	4.74 (2.12)	0.23 (0.23)	-	-	-
				1	1			
Spirodela polyrhiza	2.63 (0.54)	1.39 (0.60)	<0.01	0.24 (0.08)	0.17 (0.03)	0.20 (0.03)	0.12 (0.06)	0.13 (0.03)
	38	17	1	6	39	16	4	6
Ceratophyllum demersum	0.91 (0.33)	1.74 (0.69)	-	-	0.50 (0.17)	0.48 (0.25)	-	2.18 (1.43)
	12	9			18	5		4
Cyperus spp.	0.88 (0.28)	0.61 (0.34)	-	0.31 (0.15)	0.47 (0.24)	0.64 (0.44)	-	-
	10	3		4	11	3		
*Alternanthera philoxeroides**	0.75 (0.24)	0.77 (0.42)	-	0.22 (0.17)	0.73 (0.50)	0.64 (0.33)	0.04 (0.04)	-
	13	5		1	10	6	1	
*Myriophyllum spicatum**	-	-	0.72 (0.72)	-	-	-	-	0.22 (0.22)
			1					1
Cabomba caroliniana	0.57 (0.36)	0.06 (0.04)	-	-	0.06 (0.04)	0.11 (0.06)	-	-
	4	2			5	2		

Table 1. Continued

Plant species	2005 Canal N=52	2005 Bayou N=30	2005 Lake N=18	2005 Swamp N=8	2006 Canal N=49	2006 Bayou N=28	2006 Lake N=18	2006 Swamp N=8
Potamogeton spp.	0.11 (0.09) 2	0.36 (0.33) 1	-	-	0.13 (0.13) 1	0.10 (0.07) 2	-	-
Ludwigia peploides	0.28 (0.14) 3	0.07 (0.07) 1	-	-	0.12 (0.10) 2	0.66 (0.58) 2	-	1.40 (0.85) 2
Paspalum fluitans	<0.01 9	-	-	0.19 (0.19) 1	1.79 (0.48) 17	0.80 (0.43) 4	-	0.15 (0.15) 1
Hydrocotyle ranunculoides	-	-	-	0.10 (0.07) 1	0.13 (0.09) 2	-	-	-
Utricularia vulgaris	<0.01 1	-	-	-	-	<0.01 1	-	-
Najas guadalupensis	-	-	-	-	0.10 (0.10) 1	3.95 (2.75) 2	-	-
*Salvinia molesta**	-	-	-	-	0.03 (0.02) 2	0.05 (0.03) 2	-	-
Azolla caroliniana	-	-	-	-	<0.01 1	-	-	0.01 (0.00) 3
Mean percent coverage	1.11	1.15	0.68	9.95	1.13	1.71	0.76	4.55

Table 2. Linear equations used to estimate dry weight of plants (g) from percent coverage. Data presented are the number of samples, intercepts, slopes, mean square errors, and r^2 values for each plant. Plants that had inadequate data to produce linear equations are represented by asterisks (*).

Plant species	N Samples	Intercept	Slope	Mean Square Error	r^2
Salvinia minima	21	-2.32	28.20	38.20	0.63
Eichhornia crassipes	11	-1.16	84.29	38.29	0.72
Lemna spp.	19	0	20.90	0.01	0.65
Limnobium spongia	6	0.02	8.92	0.01	0.19
Hydrilla verticillata	8	0.63	60.30	36.70	0.41
Nelumbo lutea	*				
Spirodela polyrhiza	*				
Ceratophyllum demersum	9	0.06	23.30	0.62	0.42
Cyperus spp.	4	0.02	132.64	1.47	0.93
Alternanthera philoxeroides	4	0.18	7.53	0.37	0.45
Myriophyllum spicatum	*				
Cabomba caroliniana	*				
Potamogeton spp.	*				
Ludwigia peploides	*				
Paspalum fluitans	3	-0.04	31.81	0.39	0.70
Hydrocotyle ranunculoides	*				
Utricularia vulgaris	*				
Najas guadalupensis	2	0	62.29	0.01	1.00
Salvinia molesta	3	0	16.08	<0.01	0.89
Azolla caroliniana	3	0	11.80	<0.01	0.51

Table 3. Mean biomass of macrophytes for the four habitat types of the Atchafalaya River Basin in 2005 and 2006. Data presented are the mean dry weights in g/m^2 at locations where plants were encountered. Plant species that had inadequate data to produce linear equations are represented by asterisks (*).

	2005				2006			
Plant species	Canal	Bayou	Lake	Swamp	Canal	Bayou	Lake	Swamp
Salvinia minima	745.47	329.55	57.42	693.90	1,017.76	755.70	224.19	570.17
Eichhornia crassipes	356.45	552.72	436.43	1,751.77	295.64	0.18	216.46	260.18
Lemna spp.	45.14	20.62	37.29	237.04	4.20	3.83	1.83	10.47
Limnobium spongia	41.69	7.85	0.34	19.46	0.48	0.19	0.10	1.72
Hydrilla verticillata	200.73	214.40	-	3.37	42.82	14.98	-	104.12
Nelumbo lutea	*							
Spirodela polyrhiza	*							
Ceratophyllum demersum	17.01	32.48	-	-	9.37	8.99	-	40.68
Cyperus spp.	94.23	65.09	-	33.27	50.33	68.39	-	0.16
Alternanthera philoxeroides	4.69	4.78	-	1.48	4.55	3.98	0.40	0.14
Myriophyllum spicatum	*							
Cabomba caroliniana	*							
Potamogeton spp.	*							
Ludwigia peploides	*							
Paspalum fluitans	7.39	-	-	4.82	45.49	20.40	-	3.78
Hydrocotyle ranunculoides	*							
Utricularia vulgaris	*							
Najas guadalupensis	-	-	-	-	5.02	197.13	-	-
Salvinia molesta	-	-	-	-	0.44	4.34	-	-
Azolla caroliniana	-	-	-	-	<0.01	-	-	0.12
Total	1,512.80	1,227.49	531.48	2,743.84	1,476.10	1,078.11	442.98	991.54

of other taxa were relatively small, with the exception of hydrilla in swamps and southern naiad (*Najas guadalupensis*) in bayous.

Biomass Accumulation of Invasive Versus Native Macrophytes

Comparisons of areal coverage – dry weight regression slopes for native and invasive taxa suggested that hydrilla, water hyacinth, common salvinia, and giant salvinia accumulated more biomass per unit area than their ecologically similar native counterparts (Figures 4-6). Differences in biomass accumulation were particularly evident for the invasive plant species when areal coverage exceeded 50%.

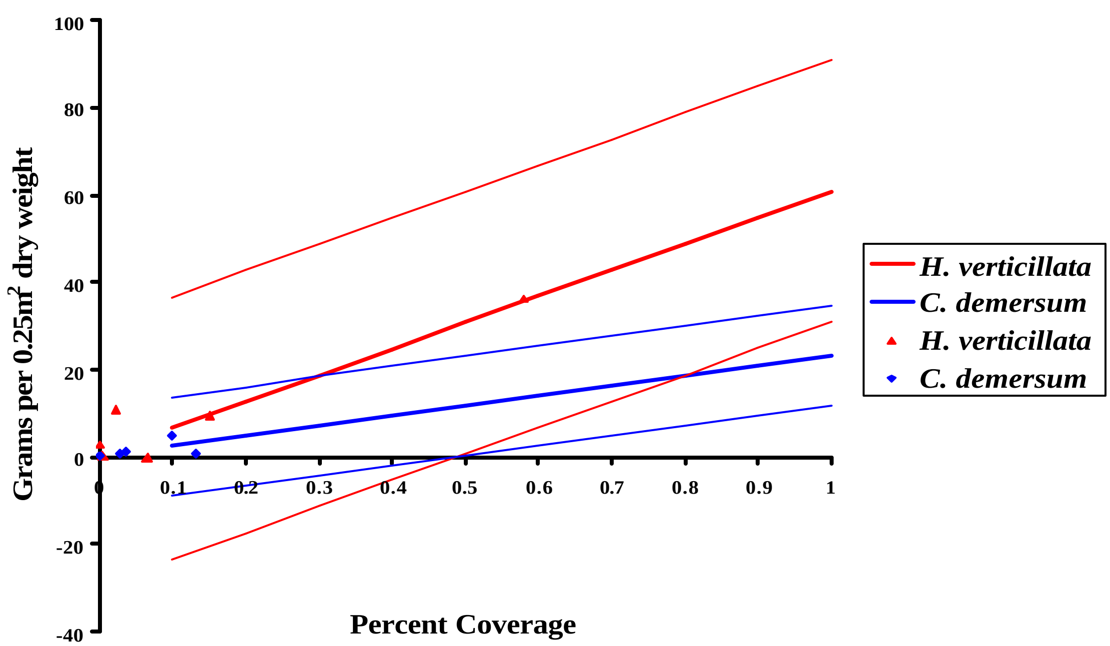

Figure 4. Areal coverage – dry weight regressions (with 95% confidence intervals) for exotic *Hydrilla verticillata* and native *Ceratophyllum demersum*. Both species are submersed macrophytes with similar complex architecture.

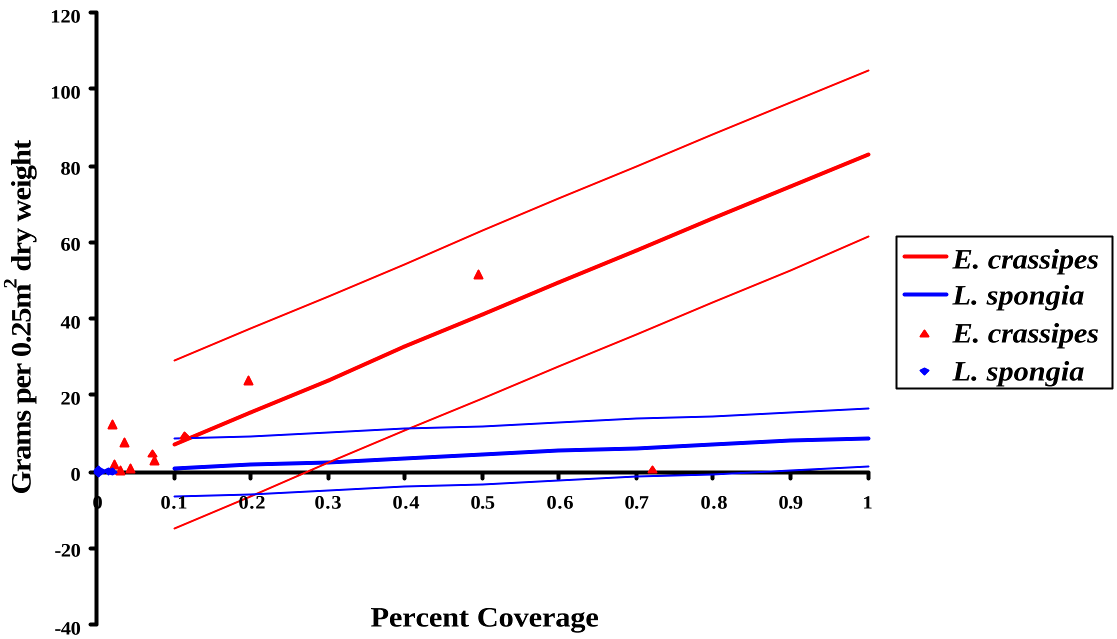

Figure 5. Areal coverage – dry weight regressions (with 95% confidence intervals) for exotic *Eichhornia crassipes* and native *Limnobium spongia*. Both species are floating macrophytes with similar growth form.

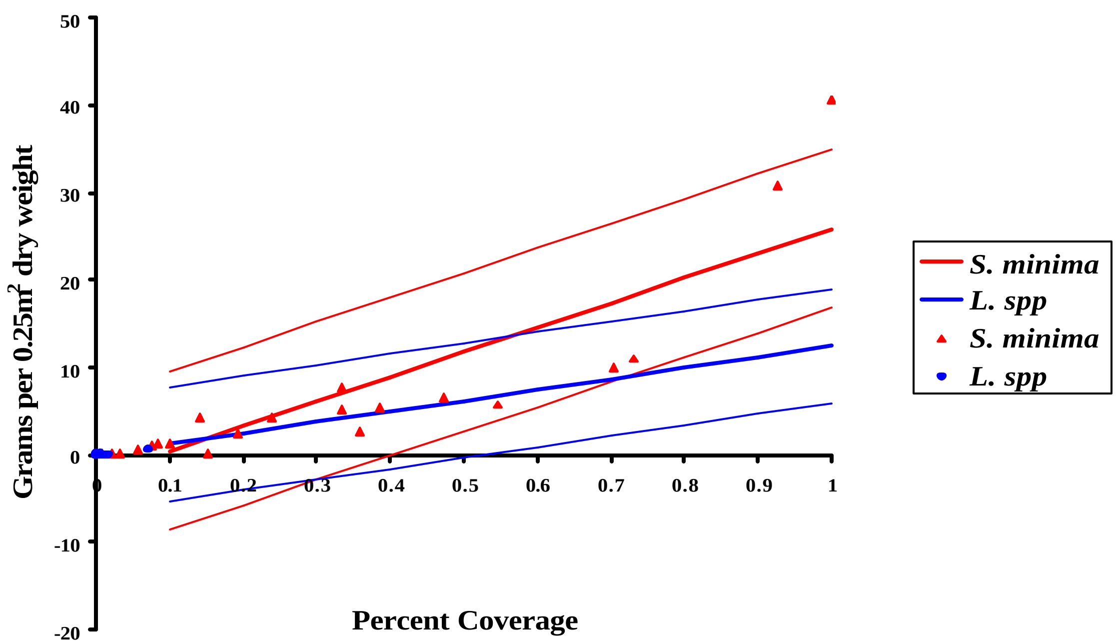

Figure 6. Areal coverage – dry weight regressions (with 95% confidence intervals) for exotic *Salvinia minima* and native *Lemna* spp. Both species are floating aquatic plants.

Physicochemical Characteristics of Sampling Locations

Analyses revealed differences in overall physicochemical characteristics among the four ARB habitats in 2005 (Wilks' Lambda $F_{57/164} = 1.89$, $p < 0.01$), with the exception of canal and lake habitats (Wilks' Lambda $F_{19/55} = 1.60$, $p = 0.08$). Contrasts further identified differences between canals and the combined natural habitats (Wilks' Lambda $F_{19/55} = 2.26$, $p < 0.01$), as well as swamp sites (Wilks' Lambda $F_{19/55} = 2.20$, $p = 0.01$), and bayou sites (Wilks' Lambda $F_{19/55} = 2.05$, $p = 0.02$) individually. Canal habitats were characterized by greater water column inorganic carbon concentrations ($F = 8.41$, $p < 0.01$) and Secchi disk depths ($F = 8.50$, $p < 0.01$) than the natural habitats, and lower phosphorus concentrations ($F = 12.22$, $p < 0.01$), pH ($F = 8.00$, $p < 0.01$), and dissolved oxygen levels ($F = 10.12$, $p < 0.01$) relative to bayous.

There were also overall differences in physicochemistry among habitat types in 2006 (Wilks' Lambda $F = {}_{57/129} = 1.58$, $p = 0.01$), but results of the *a priori* contrasts differed substantially from the 2005 analyses. Although canal habitats still differed physicochemically from the combined natural habitats (Wilks' Lambda $F = {}_{19/43}$, $p = 0.02$), contrasts revealed that canals only differed from lakes (Wilks' Lambda $F = {}_{19/43}$, $p < 0.01$), the latter of which were characterized by lower soil concentrations of calcium ($F = 11.11$, $p < 0.01$) and potassium ($F = 12.85$, $p < 0.01$), and higher soil phosphorus concentrations ($F = 11.29$, $p < 0.01$) and water flow ($F = 13.54$, $p < 0.01$).

Physicochemical Associations with Native Macrophytes

Neither year (Wilks' Lambda $F_{14/104}=1.10$, $p = 0.36$) or habitat type (Wilks' Lambda $F_{42/309} = 1.17$, $p = 0.22$) had any significant effect on abundance patterns of native plants. However, the percent coverage of invasive plant species (Wilks' Lambda

$F_{14/104}$ = 74.13, $p < 0.01$), calcium concentrations in the soil (Wilks' Lambda $F_{14/104}$ = 2.20, $p = 0.01$), potassium concentrations in the water (Wilks' Lambda $F_{14/104}$ = 2.77, $p < 0.01$), Secchi depth (Wilks' Lambda $F_{14/104}$ = 2.34, $p < 0.01$), and phosphorus concentrations in the soil (Wilk's Lambda $F_{14/104}$ = 1.85, $p = 0.04$) were significantly associated with percent coverage of several native macrophytes. Specifically, the percent coverage of invasive plants was found to be negatively associated with the percent coverage of duckweed (F = 20.09, $p < 0.01$), frog's bit (F = 24.02, $p < 0.01$), water paspalum (F = 4.17, $p = 0.04$), coontail (F = 34.79, $p < 0.01$), pondweed (F = 20.19, $p < 0.01$), and najas (F = 13.00, $p < 0.01$). Frog's bit percent coverage was positively associated with soil calcium levels (F = 11.84, $p < 0.01$) and water column potassium concentrations (F = 21.79, $p < 0.01$), and negatively associated with Secchi disk depth (F = 8.26, $p < 0.01$). Soil calcium levels were also positively associated with the abundance of flatsedges (F = 5.73, $p = 0.02$) and water paspalum (F = 7.37, $p < 0.01$), but negatively associated with the abundance of pondweed (F = 6.21, $p = 0.01$). Fanwort abundance was positively associated with water column potassium concentrations (F = 22.62, $p < 0.01$), whereas duckweed abundance was positively related to soil phosphorus concentrations (F = 27.30, $p < 0.01$).

Physicochemical Associations with Invasive Macrophytes

As found for native macrophytes, habitat type had no detectable effect on the abundance of invasive plants (Wilks' Lambda $F_{14/104}$=1.10, $p = 0.36$). However, the year effect was significant (Wilks' Lambda $F_{6/112}$ = 3.54, $p < 0.01$), which may have been due in part to the addition of giant salvinia to the invasive community in 2006. Factors associated with the abundances of invasive macrophytes included the percent coverage of

native plants (Wilks' Lambda $F_{6/112} = 265$, $p < 0.01$), potassium concentrations in the soil (Wilks' Lambda $F_{6/112} = 2.23$, $p = 0.04$), phosphorus concentrations in the water (Wilks' Lambda $F_{6/112} = 2.37$, $p = 0.03$), water column pH (Wilks' Lambda $F_{6/112} = 3.79$, $p < 0.01$), and dissolved oxygen (Wilks' Lambda $F_{6/112} = 3.38$, $p < 0.01$). Common salvinia was the only taxa that was negatively associated with the percent coverage of native plants ($F = 65.89$, $p < 0.01$), and also exhibited a positive association with soil potassium concentrations ($F = 20.95$, $p < 0.01$). Water hyacinth ($F = 5.54$, $p = 0.02$) and watermilfoil ($F = 13.25$, $p < 0.01$) were negatively associated with soil potassium concentrations, whereas hydrilla was negatively associated with water column pH ($F = 16.72$, $p < 0.01$), and dissolved oxygen levels ($F = 4.56$, $p = 0.03$). Similar to hydrilla, water hyacinth was also negatively associated with water column pH ($F = 8.54$, $p < 0.01$), whereas alligatorweed exhibited a positive association with water column phosphorus concentrations ($F = 8.66$, $p < 0.01$).

Macrophyte Associations

Analyses of functionally grouped macrophyte associations yielded three principal component (PC) in both 2005 (Table 4) and 2006 (Table 5) with eigenvalues greater than 1.0 that together explained 57% and 60% of the variation in the data sets, respectively. Native terrestrial plants were associated with a floating group in 2005 (PC 1) and 2006 (PC 2). Overall MANOVAs for 2005 and 2006 indicated that the three PCs for each year differed among habitat types (2005, Wilks' Lambda $F_{9/248} = 6.24$, $p < 0.01$; 2006, Wilks' Lambda $F_{9/236} = 2.96$, $p < 0.01$). In 2005, PC 1 and PC 3 scores differed among habitat types (PC 1, $F = 4.24$, $p < 0.01$; PC 3, $F = 12.03$, $p < 0.010$), with PC 1 associated more with manmade canals and swamps than lakes ($p < 0.01$) and bayous ($p = 0.02$), and PC 3

associated more with swamps than manmade canals ($p < 0.01$). In the 2006 analyses, PC 2 was very similar to PC 1 in 2005, with an overall difference among habitat types ($F = 7.35$, $p < 0.01$), and greater association with both manmade canals and swamps than lakes ($p < 0.01$) and bayous ($p < 0.01$). In 2006, PC 1 and other PCs that were characterized by submersed native or invasive plants did not differ across the four habitat types.

Differences between Vegetated and Non-vegetated Locations within Years

The full model of the logistic regression indicated that there were no differences in the prevalence of vegetated or non-vegetated locations in 2005 (72.3%) and 2006 (70.6%). However, in 2005, pH was lower at vegetated locations, both for all plant taxa (Wald chi-square $_{df = 1} = 8.1$, $p < 0.01$) as well as native plant taxa considered alone (Wald chi-square $_{df = 1} = 7.4$, $p < 0.01$). In 2006, locations inhabited by native plants were characterized by lower organic matter accumulations in the soil (Wald chi-square $_{df = 1} = 3.9$, $p = 0.04$).

Table 4. Principal component analysis of aquatic macrophyte groups within quadrats sampled in 2005. Only correlations between groups and principal components = 0.5 are shown. The percentage of the total variance in the data explained by each PC is in parentheses.

Group type	PC1 (23.6)	PC2 (18.5)	PC3 (14.8)
Native Terrestrial	0.82		
Native Floating	0.66		
Native Submersed		0.76	
Native Emersed			0.85
Invasive Floating			0.55
Invasive Submersed		0.82	
Invasive Emersed	0.63		

Table 5. Principal component analysis of aquatic macrophyte groups within quadrats sampled in 2006. Only correlations between groups and principal components = 0.5 are shown. The percentage of the total variance in the data explained by each PC is in parentheses.

Group type	PC1 (26.2)	PC2 (18.2)	PC3 (15.9)
Native Terrestrial		0.77	
Native Floating	0.89		
Native Submersed			0.67
Native Emersed			
Invasive Floating		0.76	
Invasive Submersed			0.74
Invasive Emersed	0.91		

Among the invasive plants, there were both taxonomic and annual differences in the percentages of locations inhabited by hydrilla (40.4% in 2005, 21.5% in 2006), alligatorweed (18.0 in 2005, 16.1 in 2006), water hyacinth (48.9% in 2005, 37.6% in 2006), common salvinia (70.2% in 2005, 68.8% in 2006), and giant salvinia (0.0% in 2005, 4.3% in 2006). Similar to the distributional patterns of native plants in 2005, locations inhabited by water hyacinth (Wald chi-square $_{df = 1}$ = 18.2, $p < 0.01$) and common salvinia (Wald chi-square $_{df = 1}$ = 7.7, $p < 0.01$) in 2005 and water hyacinth in 2006 (Wald chi-square $_{df = 1}$ = 4.5, $p = 0.03$) exhibited lower pH relative to locations where these plants did not occur. In addition, locations supporting alligatorweed in 2005 exhibited lower water column concentrations of potassium (Wald chi-square $_{df = 1}$ = 4.4, $p = 0.03$) and total nitrogen (Wald chi-square $_{df = 1}$ = 4.0, $p = 0.04$) than non-inhabited areas, whereas locations inhabited by common salvinia in 2006 showed higher levels of soil organic matter (Wald chi-square $_{df = 1}$ = 3.9, $p = 0.04$) relative to uninhabited sites.

Year-to-year Changes in Plant Communities within a Location

The CDFA of locations sampled both years indicated a greater dominance of water hyacinth, alligatorweed, hydrilla, frog's bit, coontail, and duckweed in 2005, and

flatsedges, mosquito fern, giant salvinia, floating pennywort (*Hydrocotyle ranunculoides*), and water paspalum in 2006 (Figure 7). Paired t-tests indicated that differences in plant community composition between years at the same sampling location were significant ($t_{102} = 7.10$, $p < 0.01$), and the reduced model identified 22 locations (2 bayou, 4 swamp, and 16 canals) that exhibited differences of at least two units along the CDFA axis (Figure 8). The CDFA of location physicochemistry also revealed differences ($t_{21} = 12.76$, $p < 0.01$) between years at the 22 locations. Analyses indicated that locations in 2005 were characterized by greater concentrations of soil phosphorus and water column potassium, carbon (TC, TOC, and DOC), nitrogen, and salinity, whereas in 2006 these areas exhibited greater dissolved oxygen levels and soil potassium concentrations (Figure 9).

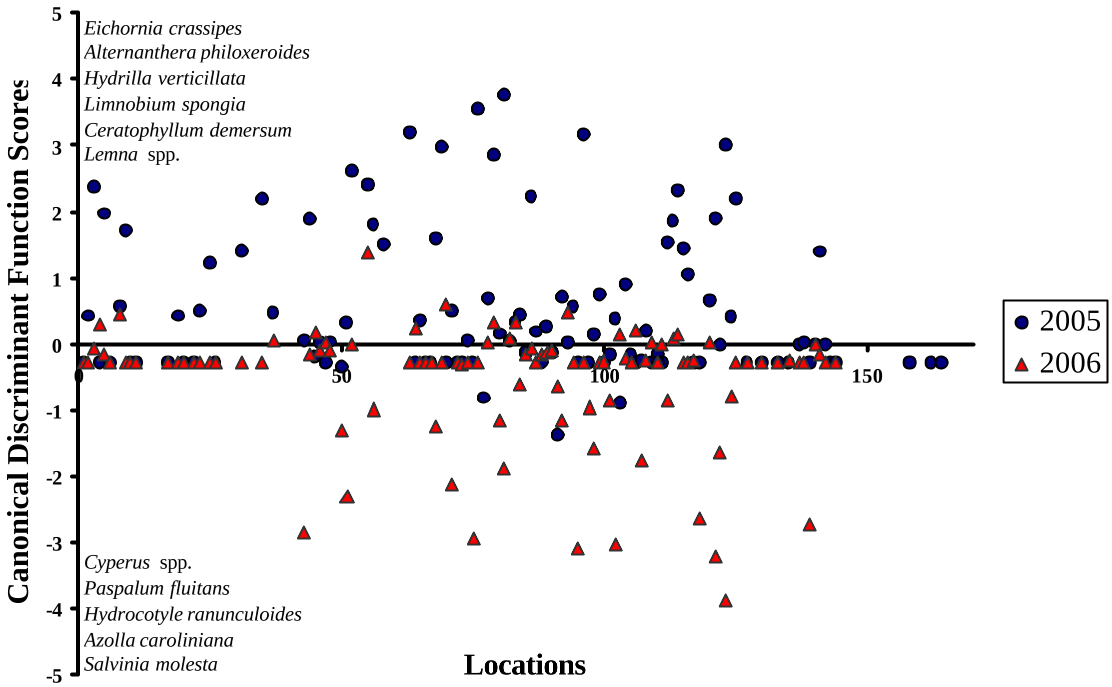

Figure 7. Canonical discriminant function analysis of the plant community data for each location in 2005 and 2006. Differences in scores between years for each location on the CDFA axis is how much the plant community changed at that location during this study. Pooled coefficients are shown.

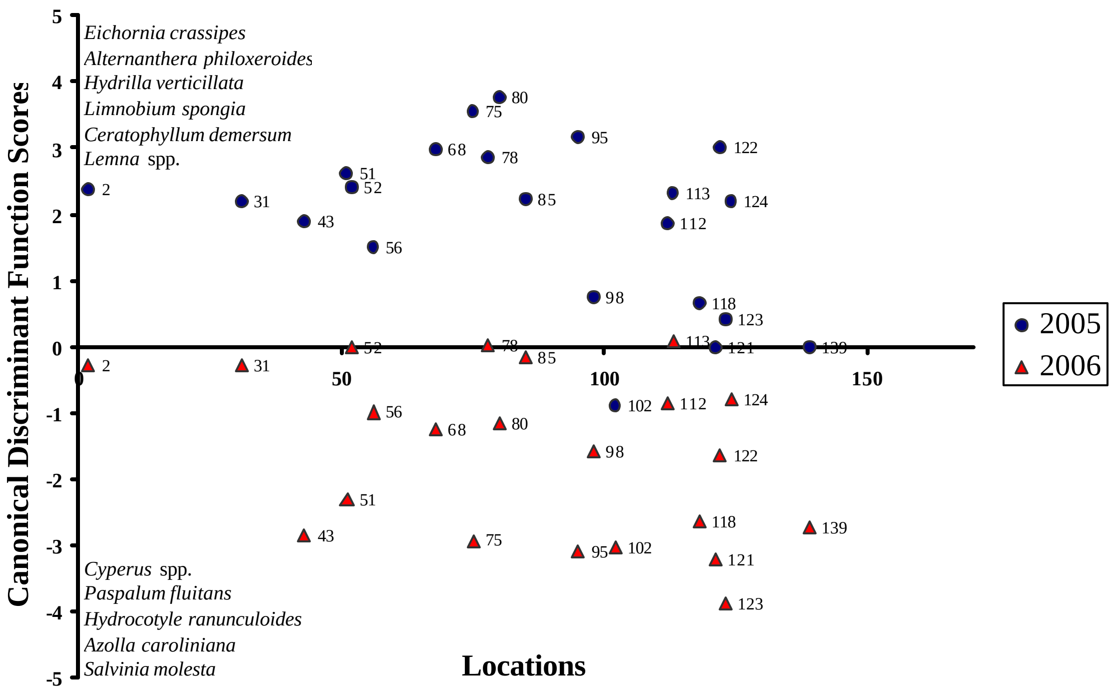

Figure 8. Canonical discriminant function analysis of the plant community with the 22 out of 103 locations sampled that had a distance greater than two units along the CDFA axis. Differences in scores between years for each location on the CDFA axis is how much the plant community changed at that location during this study. Pooled coefficients are shown.

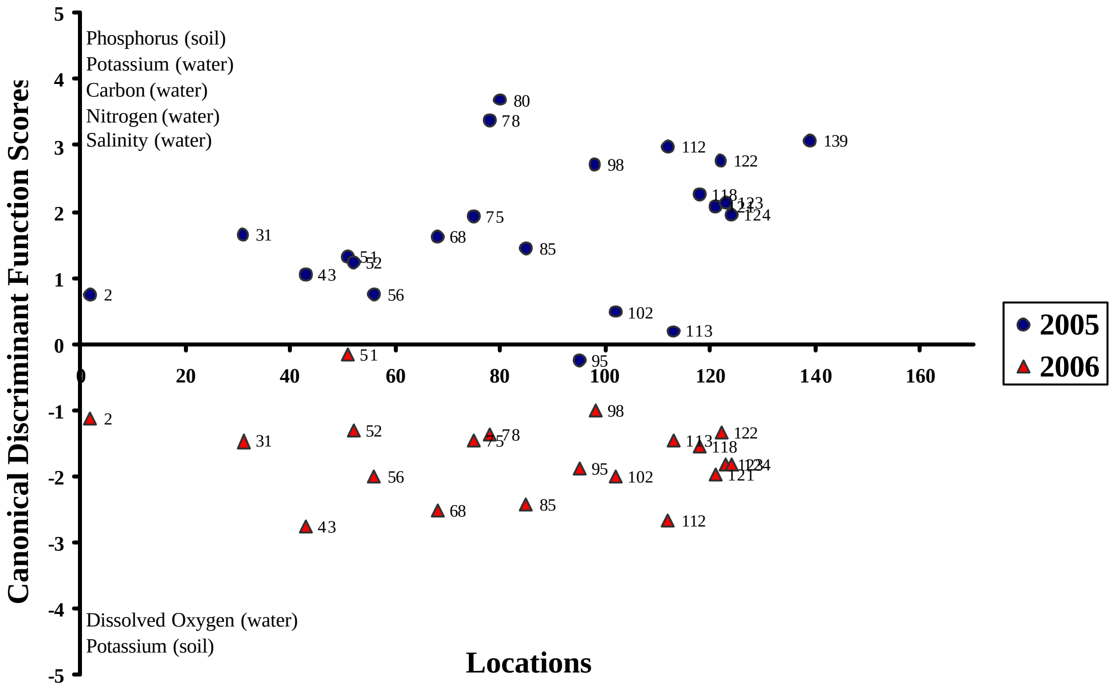

Figure 9. Canonical discriminant function analysis of the physicochemical data for the 22 locations from the reduced model. Pooled coefficients are shown.

DISCUSSION

The purpose of this study was to gain a better understanding of the structure and dynamics of the aquatic plant community in the ARB, particularly the abundance of invasive plants and their interactions with native plant taxa. Water hyacinth, first documented in Louisiana in the 1880s, and common salvinia, recorded about 100 years later, dominated the macrophyte community across all four habitat types during both years. These taxa, along with hydrilla and other native macrophytes were particularly abundant along canals and bayous, probably due in part to the constant boat traffic in these areas that facilitated colonization and dispersal by cuttings. This is a common trend that is also observed in terrestrial plants communities, where species tend to be the most abundant along right of ways (Lathrop et al. 1980; Zink et al. 1995).

Invasive macrophytes have often been found to be superior competitors relative to native species (Armstrong 1995), and comparison of the regression lines of areal coverage versus biomass for ecologically similar native and invasive plants indicates that an increased growth potential may be one reason for this competitive advantage. Although data for most of the regression analyses were insufficient to show statistical differences in line slopes, the consistent trend of higher invasive plant biomass increases with increasing areal coverage is interesting. Most of the data that went into the regressions were for lower levels of areal coverage, and collection of more data for samples with high percentages of areal coverage for most of the plants (although this was uncommon for native taxa) would improve these analyses. Further, low r^2 values may reflect measurement error or non linear relationships between areal coverage and biomass. However, these results are consistent with other research that has investigated

the abilities of non-native macrophytes to successfully invade new habitats. These studies have shown that invasive species are more productive than native species (Hauxwell et al. 2004; Olguin et al. 2007), can have a genetic advantage over natives due to post-introduction adaptations (Siemann et al. 2001), can outcompete native plants for resources (Callaway et al. 2000; Ehrenfeld 2003), and benefit from predatory release in their new range (Thomas et al.1986 a; Room et al. 1992).

Even though analyses indicated substantial differences in physicochemical conditions among lake, bayou, swamp, and canal habitats, ARB macrophytes did not exhibit consistent preferences for specific habitat types. This could be due to the large size and connectivity of the water bodies within the ARB, particularly during the flood pulse, or preferences could be cyclic and observed only through long-term surveillance. Nutrients that were associated with the macrophyte presence or abundance were calcium, potassium, phosphorus, and nitrogen, and these nutrients could be limiting factors for some species in the ARB macrophyte community. However, an important question is whether the observed associations were due to the nutrients influencing plant distribution, or whether the plants influenced measured nutrient levels. Other studies have shown that the presence of aquatic macrophytes is correlated with an accumulation of certain macronutrients. Smith et al. (1983) found that calcium ions were found in aquatic plant tissues in the form of oxalates that entered back into the system as either chelates or detritus. Misra (1938) found a relationship between organic matter from plant decay and an increase of calcium and nitrogen in the substratum. Frodge et al. (1991) observed internal loading of phosphorus at the sediment-water interface beneath dense canopies of aquatic vegetation, and Ozimek et al. (1993) and Borum et al. (1989) both found that not

only did plants grow better in nitrogen enriched waters, they accumulated nitrogen in their tissues. Wenchao (1997) observed that wherever aquatic plants were present there tended to be an increase of surface-sediment nitrogen that accumulated through biological sedimentation. While other studies do not show an accumulation of potassium occurring with increasing macrophyte coverage, or enhanced plant growth related to potassium exposure, Best et al. (1996) found that when plants were exposed to a combination of macronutrients that included potassium, plant growth significantly increased.

Other factors that tended to be associated with the composition and abundance of the ARB macrophyte community, such as levels of pH, dissolved oxygen, and organic matter may have been mostly a consequence of plant bed development rather than a driving force behind macrophyte community dynamics. My study showed that hydrilla was associated with low levels of pH and dissolved oxygen at 0.2 meters below the water's surface. Similarly, Carter et al. (1991) observed that although surface levels of pH and dissolved oxygen were high in the hydrilla canopy, both decreased with depth in the water column. Stock et al. (1995) found that the introduction of an acacia species was correlated with organic matter enrichment as plant stands developed, and Thomas et al. (1986b) found similar increases in organic loading as floating vegetation sunk, decayed, and consumed oxygen. Miranda et al. (2000) reported an overall inverse relationship between dissolved oxygen levels and plant presence, although pockets of normoxic water were present even in dense macrophyte beds.

In this study, common salvinia appeared to have the greatest impact on the native ARB plant community, exhibiting inverse abundance relationships with six of the

fourteen native species in this study (43%). Field observations indicated that common salvinia was the only species that ever displayed a monospecific stand with 100% coverage. Common salvinia has been found to be a dominant invasive species in other parts of Louisiana (Nolfo-Clements 2006), but its close relative, giant salvinia, is more often dominant in other waterways in southeastern states (USGS 2005). This may be due to successful biological control of common salvinia in environments that are suitable for establishment of the Florida strain of the salvinia weevil *Cyrtobagous salviniae* (Jacono et al. 2001).

Plant group associations that were revealed by the PCA were mirrored by field observations during both 2005 and 2006. In both years, terrestrial plants (water paspalum and flatsedges) were only observed in association with floating mats of other macrophyte species, apparently taking advantage of the mats as a "terrestrial" substrate. Interestingly, these plants were associated with floating mats of native species in 2005 and mats of invasive species in 2006, indicating that substrate type was unimportant in the development of aquatic stands of these terrestrial plants. Other studies have shown that some species of floating vegetation are associated with other plant species (typically of higher succession), and these associations may facilitate succession of shallow wetlands to terrestrial systems (Adams et al. 2002; Jursa et al. 2005; Omondi et al. 2006). Native and invasive submerged plants exhibited few significant differences in abundance among the four ARB habitats, although they did tend to occur where floating plants were not abundant. This was likely related to increased levels of sub-surface light in areas where floating taxa were absent, which has been reported in other studies of macrophyte community composition (Hough et al. 1989; Janes et al. 1996). Within the submerged

macrophyte community, it is interesting that both native and invasive submerged plants consistently occurred together when submerged plants were encountered. Native coontail was often seen at the margins of hydrilla beds (but almost never within the bed), and its rootless, free-floating growth form (Godfrey et al. 1981) may allow it to persist in areas that have lost other species of native macrophytes because of hydrilla overgrowth. Janauer et al. (2006) observed that coontail preferred rip-rapped habitats, which the plants used for anchorage, and the edges of dense hydrilla beds in the ARB may serve a similar function.

Analyses revealed few physicochemical differences among vegetated and non-vegetated sites for native or invasive plants. Evidence of lower pH at vegetated sites (versus un-vegetated) for both native (2005) and invasive (2005 and 2006) plants is contrary to what I would have expected, as all water quality data was recorded during the day, when algal photosynthesis should have reduced water column CO_2 concentrations and increased pH levels (Horne et al. 1994). Perhaps this trend was due to the prevalence of duckweed and frog's bit in the native plant community during 2005, and common salvinia and water hyacinth in the invasive plant community in both years. As all of these taxa shade the water column, they may have inhibited algal productivity, increased respiration and CO_2 production, and lowered the water column pH, similar to results reported by Vieira et al. (2003) and Gosselain et al. (2005). Fernandez-Valiente et al. (2004) also observed that the level of shading from rice plants affected algal photosynthetic rates, which in turn affected the pH and dissolved oxygen levels in the water. In contrast to these studies, I did not observe significant reductions in dissolved oxygen levels associated with reduced pH. However, dissolved oxygen dynamics in the

ARB are extremely complex due to high decomposition rates and continual fluctuations in water levels, and it may be that water column oxygen levels are not as closely tied to vegetative cover as in other, more lentic systems.

The stochastic nature of macrophyte distribution in the ARB was particularly evident in the within-location changes in the invasive plant community between 2005 and 2006. Although some of the differences may have been due to the appearance of giant salvinia, the CDFA revealed large changes in plant community composition and physicochemistry between the two years at approximately 25% of the study locations. These changes highlight the dynamic nature of the ARB littoral zone and the multiplicity of factors that likely affect the composition of the resident macrophyte community. Little ecological information involving temporal changes in ecosystem structure and function following exotic species introductions is available, typically due to the lack of monitoring prior to the introduction (Blossey 1999). However, Boylen et al. (1999) found a decline in species richness and abundance of native plants during a ten year study in Lake George, New York, after introduction of Eurasian watermilfoil (*Myriophyllum spicatum*). Evidence of significant ecosystem change was also reported by de Winton et al. (1996) who found that beds produced by three introduced aquatic macrophytes in New Zealand lakes lead to the decline in species richness in the native seed banks.

I recommend that future research on the ARB aquatic macrophyte community focus on the expanding range of giant salvinia, as well as spatial and temporal variability in the abundance of all invasive aquatic plants. I also believe that additional analyses at representative lake, swamp, bayou, and canal locations, focusing on large-scale phenomena such as the annual ARB flood pulse, in addition to microhabitat studies,

could help discern the complex abundance patterns exhibited by native and invasive macrophytes. It would also be beneficial to study the nutrient requirements of individual macrophyte species from different habitats in conjunction with controlled laboratory experiments to investigate the potential for limiting nutrients in this system. The ARB is an important resource and these types of studies are imperative for developing the proper management tools to minimize the negative impacts of these aggressive macrophyte species, and maximize the biotic and recreational potential of this unique river-floodplain system.

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APPENDIX A: WATER QUALITY DATA

Values shown are averages for each location.

Location	Type	Year	PO_4^{3-}	K	TN	TC	IC	TOC	DOC
1	Lake	2005	0.45	3.17	1.12	36.22	28.76	7.46	6.64
2	Swamp	2005	0.57	3.40	0.75	38.23	30.36	7.87	7.59
3	Lake	2005	0.22	4.10	1.01	36.30	29.02	7.28	6.91
4	Swamp	2005	0.24	3.27	0.67	35.91	28.10	7.81	6.97
5	Lake	2005	0.31	8.93	0.64	35.27	26.70	8.57	8.19
6	Lake	2005	0.40	6.45	0.64	35.16	26.63	8.53	8.14
8	Man canal	2005	0.76	10.60	0.62	40.80	30.93	9.87	8.98
9	Lake	2005	0.30	10.20	0.60	35.69	27.05	8.64	8.16
10	Lake	2005	0.34	12.20	0.67	36.77	27.01	9.76	8.64
11	Lake	2005	0.42	9.30	0.64	34.45	26.45	8.00	7.70
17	Man canal	2005	0.37	6.20	0.73	35.37	27.06	8.31	7.81
19	Lake	2005	0.23	5.50	0.56	34.12	27.18	6.94	6.59
20	Bayou	2005	0.29	5.05	0.65	33.20	26.10	7.10	6.84
22	Bayou	2005	0.29	6.50	0.65	35.45	27.68	7.77	7.71
23	Bayou	2005	0.26	5.65	0.63	35.06	26.70	8.36	8.12
25	Lake	2005	0.25	6.20	0.54	36.18	28.07	8.11	7.78
26	Bayou	2005	0.30	9.20	0.67	39.82	29.25	10.58	9.20
31	Man canal	2005	0.35	11.60	0.72	42.66	31.15	11.52	10.84
35	Man canal	2005	0.25	4.75	0.65	39.67	31.28	8.38	7.85
37	Swamp	2005	0.25	7.95	0.57	37.82	27.72	10.11	8.28
43	Man canal	2005	0.43	6.60	0.63	36.83	27.34	9.48	8.96
44	Man canal	2005	0.46	5.45	0.60	34.41	26.09	8.31	7.85
45	Man canal	2005	0.54	8.10	0.71	40.06	28.35	11.72	10.37

Location	Type	Year	Secchi	Flow	Depth	pH	Salinity	D.O.	Ca
1	Lake	2005	230	3.7	2.2	7.76	0.22	2.19	.
2	Swamp	2005	0	0.0	0.8	6.83	0.21	0.70	.
3	Lake	2005	390	12.4	1.1	7.63	0.22	2.42	.
4	Swamp	2005	0	0.0	0.5	7.02	0.21	1.87	.
5	Lake	2005	150	5.3	1.3	7.86	0.48	3.68	.
6	Lake	2005	500	19.6	0.5	7.28	0.39	2.22	.
8	Man canal	2005	400	45.1	0.4	7.78	0.45	4.46	.
9	Lake	2005	300	3.0	1.7	7.74	0.50	3.67	.
10	Lake	2005	330	6.9	1.2	7.50	0.56	3.36	.
11	Lake	2005	215	0.0	1.1	7.46	0.41	3.14	.
17	Man canal	2005	300	36.4	2.7	7.25	0.36	2.46	.
19	Lake	2005	245	7.5	0.8	8.47	0.29	4.62	.
20	Bayou	2005	325	18.7	6.0	8.29	0.27	4.26	.
22	Bayou	2005	375	22.3	2.6	7.75	0.32	4.78	.
23	Bayou	2005	390	18.2	2.0	7.67	0.32	4.81	.
25	Lake	2005	190	0.9	0.4	8.19	0.35	4.36	.
26	Bayou	2005	440	13.4	4.1	7.52	0.38	3.25	.
31	Man canal	2005	680	0.5	1.5	7.45	0.51	4.17	.
35	Man canal	2005	370	0.4	0.9	7.83	0.31	5.33	.
37	Swamp	2005	390	6.2	1.5	7.53	0.37	2.96	.
43	Man canal	2005	460	6.8	2.3	7.25	0.37	2.43	.
44	Man canal	2005	420	11.3	2.2	7.54	0.34	3.70	.
45	Man canal	2005	900	6.9	1.7	7.17	0.34	2.08	.
46	Man canal	2005	500	4.6	2.7	7.27	0.37	2.28	.
47	Bayou	2005	560	4.2	1.5	7.26	0.37	2.66	.
48	Man canal	2005	560	0.9	0.8	7.12	0.42	2.00	.
50	Bayou	2005	410	0.0	1.2	7.59	0.35	3.41	.

Location	Type	Year	PO_4^{3-}	K	TN	TC	IC	TOC	DOC
46	Man canal	2005	0.45	8.50	0.60	39.62	28.86	10.76	10.03
47	Bayou	2005	0.39	5.10	0.63	34.40	26.03	8.37	7.91
48	Man canal	2005	0.46	8.10	0.60	36.25	26.96	9.29	8.42
50	Bayou	2005	0.29	6.35	0.73	35.89	27.36	8.53	7.94
51	Man canal	2005	0.52	7.70	0.61	40.35	27.05	13.31	11.15
52	Man canal	2005	0.76	7.80	0.69	45.17	34.04	11.14	11.74
55	Man canal	2005	0.27	5.50	0.57	35.64	27.34	8.30	7.85
56	Bayou	2005	0.22	5.35	0.53	34.53	26.27	8.26	7.76
58	Bayou	2005	0.15	3.80	0.54	38.01	17.89	20.13	8.85
63	Lake	2005	0.47	4.50	0.53	31.31	22.10	9.21	8.69
64	Bayou	2005	0.35	3.95	0.60	36.89	21.25	15.64	15.62
65	Lake	2005	0.38	4.25	0.54	33.98	21.19	12.80	8.39
66	Lake	2005	0.44	4.40	0.52	33.26	21.26	12.00	9.27
67	Bayou	2005	0.14	3.20	0.51	39.89	18.34	21.53	9.52
68	Man canal	2005	0.32	3.35	0.71	38.64	17.33	21.31	10.41
69	Lake	2005	0.38	4.25	0.53	33.22	22.56	10.67	8.67
70	Bayou	2005	0.31	3.45	0.53	36.99	22.96	14.03	11.42
71	Bayou	2005	0.19	3.50	0.55	39.09	18.03	21.07	9.33
72	Lake	2005	0.36	3.95	0.53	32.27	24.69	7.58	6.01
73	Man canal	2005	0.19	3.60	0.51	38.39	17.93	20.46	10.69
74	Bayou	2005	0.38	3.35	2.94	36.30	27.73	8.57	8.43
75	Man canal	2005	0.25	3.20	2.31	49.78	22.65	27.13	14.71
76	Man canal	2005	0.12	4.15	0.44	31.91	24.81	7.09	7.00
77	Man canal	2005	0.26	3.80	0.47	32.27	26.28	5.99	5.53
78	Man canal	2005	0.38	10.60	0.65	41.09	29.31	11.79	11.56
79	Bayou	2005	0.29	3.05	0.51	28.31	21.67	6.65	6.49
80	Man canal	2005	0.52	12.70	0.83	43.01	31.76	11.25	10.34
81	Man canal	2005	0.17	3.70	0.48	32.86	26.05	6.81	6.25

Location	Type	Year	Secchi	Flow	Depth	pH	Salinity	D.O.	Ca
51	Man canal	2005	1020	21.2	1.7	7.18	0.36	1.95	.
52	Man canal	2005	690	0.0	0.9	7.10	0.32	0.75	.
55	Man canal	2005	490	9.6	1.5	7.54	0.32	3.19	.
56	Bayou	2005	405	7.4	2.2	7.55	0.33	3.87	.
58	Bayou	2005	400	4.4	1.2	7.54	0.27	2.04	.
63	Lake	2005	570	3.4	2.0	7.90	0.25	2.26	.
64	Bayou	2005	460	0.9	1.5	8.21	0.24	2.55	.
65	Lake	2005	490	1.6	2.0	8.26	0.25	2.63	.
66	Lake	2005	420	1.3	1.6	8.08	0.26	2.82	.
67	Bayou	2005	0	0.0	0.7	7.09	0.25	1.19	.
68	Man canal	2005	0	0.0	1.0	7.40	0.26	1.85	.
69	Lake	2005	490	1.2	2.5	8.57	0.30	3.25	.
70	Bayou	2005	340	0.0	1.0	7.73	0.24	2.50	.
71	Bayou	2005	550	8.6	2.0	8.24	0.26	2.04	.
72	Lake	2005	410	0.0	2.3	8.70	0.28	3.06	.
73	Man canal	2005	370	7.9	3.2	7.62	0.26	2.04	.
74	Bayou	2005	370	33.0	1.0	8.51	0.24	2.76	.
75	Man canal	2005	0	0.0	0.3	6.84	0.29	0.50	.
76	Man canal	2005	480	2.1	1.1	7.48	0.29	2.83	.
77	Man canal	2005	660	0.0	2.0	7.14	0.24	1.33	.
78	Man canal	2005	0	0.0	2.2	7.22	0.61	0.48	.
79	Bayou	2005	380	4.9	1.0	7.58	0.26	2.81	.
80	Man canal	2005	0	0.0	2.1	7.22	0.71	0.61	.
81	Man canal	2005	730	1.7	1.7	7.87	0.25	2.75	.
82	Man canal	2005	840	3.3	0.7	7.24	0.65	0.81	.
83	Man canal	2005	325	6.0	0.8	8.05	0.26	2.57	.
84	Swamp	2005	0	0.0	1.1	7.08	0.26	0.69	.
85	Man canal	2005	0	0.0	0.9	7.24	0.35	1.31	.

Location	Type	Year	PO_4^{3-}	K	TN	TC	IC	TOC	DOC
82	Man canal	2005	0.65	10.70	0.79	41.46	30.24	11.23	10.48
83	Man canal	2005	0.37	3.40	0.75	35.31	28.46	6.85	6.17
84	Swamp	2005	0.21	3.80	0.49	34.77	28.40	6.36	6.01
85	Man canal	2005	0.38	6.85	0.88	37.92	27.11	10.81	10.21
86	Man canal	2005	0.32	3.50	0.63	35.80	27.75	8.05	7.49
87	Bayou	2005	0.16	3.60	0.50	33.13	25.94	7.19	5.82
88	Man canal	2005	0.22	3.55	0.51	32.11	25.95	6.17	6.04
89	Man canal	2005	0.33	3.35	0.73	29.02	23.69	5.33	5.08
90	Man canal	2005	0.31	3.80	0.72	29.36	24.09	5.27	5.01
91	Man canal	2005	0.19	3.70	0.64	31.00	25.29	5.71	5.39
92	Man canal	2005	0.19	3.90	0.55	32.29	26.63	5.65	5.15
93	Man canal	2005	0.32	3.35	0.65	34.67	27.06	7.61	7.05
94	Lake	2005	0.59	3.40	0.54	35.70	29.21	6.48	5.60
95	Man canal	2005	0.21	3.95	0.60	33.11	26.22	6.90	6.55
96	Lake	2005	0.55	3.20	0.49	34.38	27.81	6.57	6.16
97	Man canal	2005	0.27	4.00	0.52	38.38	29.26	9.12	7.80
98	Man canal	2005	0.76	10.40	0.75	40.22	28.32	11.90	11.34
99	Lake	2005	0.56	3.35	0.56	37.56	21.49	16.08	14.42
100	Man canal	2005	0.12	2.50	0.51	38.69	17.61	21.09	9.80
101	Bayou	2005	0.28	3.70	0.54	34.52	26.34	8.18	7.93
102	Man canal	2005	0.30	3.50	0.51	34.70	26.31	8.39	8.18
103	Swamp	2005	0.46	4.25	0.77	32.98	25.58	7.39	7.15
104	Man canal	2005	0.31	3.90	0.47	32.45	23.53	8.92	8.69
105	Bayou	2005	0.65	3.20	0.57	39.97	25.41	14.56	13.36
106	Bayou	2005	0.23	3.45	0.62	39.83	18.38	22.80	12.18
107	Man canal	2005	0.02	3.75	0.52	39.90	18.16	21.75	11.82
108	Bayou	2005	0.27	3.10	0.52	37.63	17.65	20.07	9.12
109	Bayou	2005	0.29	3.85	0.45	33.21	24.99	8.22	7.43

Location	Type	Year	Secchi	Flow	Depth	pH	Salinity	D.O.	Ca
86	Man canal	2005	375	13.5	1.1	8.24	0.26	2.57	.
87	Bayou	2005	480	11.7	1.4	8.04	0.24	2.58	.
88	Man canal	2005	340	10.7	1.6	7.82	0.24	2.76	.
89	Man canal	2005	350	4.0	2.2	7.97	0.23	2.18	.
90	Man canal	2005	360	8.1	1.6	7.92	0.23	2.14	.
91	Man canal	2005	450	8.0	1.3	7.55	0.24	1.88	.
92	Man canal	2005	260	2.3	1.4	7.28	0.25	1.47	.
93	Man canal	2005	300	8.8	1.1	8.10	0.26	2.62	.
94	Lake	2005	370	2.1	1.0	8.31	0.25	2.55	.
95	Man canal	2005	530	0.0	0.8	7.01	0.25	1.95	.
96	Lake	2005	330	5.2	1.4	8.49	0.25	2.43	.
97	Man canal	2005	0	0.0	1.5	7.26	0.26	1.43	.
98	Man canal	2005	1050	0.0	1.9	7.25	0.39	0.75	.
99	Lake	2005	280	0.0	1.0	8.52	0.25	2.48	.
100	Man canal	2005	550	4.8	1.4	8.64	0.25	2.55	.
101	Bayou	2005	390	5.3	0.6	8.05	0.24	2.77	.
102	Man canal	2005	480	1.7	2.1	7.82	0.25	2.45	.
103	Swamp	2005	0	0.0	0.9	7.57	0.24	1.96	.
104	Man canal	2005	530	0.9	1.1	7.37	0.25	1.16	.
105	Bayou	2005	400	4.5	1.5	7.97	0.24	2.01	.
106	Bayou	2005	490	5.4	1.6	7.88	0.33	2.57	.
107	Man canal	2005	510	2.5	0.7	7.56	0.25	2.56	.
108	Bayou	2005	370	4.4	0.7	8.65	0.25	2.68	.
109	Bayou	2005	200	0.0	1.1	7.72	0.26	2.16	.
110	Bayou	2005	240	0.0	0.7	7.78	0.25	1.98	.
111	Man canal	2005	260	9.2	0.9	8.19	0.25	2.70	.
112	Man canal	2005	180	2.1	0.7	8.46	0.24	2.43	.
113	Man canal	2005	510	4.4	0.3	7.52	0.24	2.01	.

Location	Type	Year	PO_4^{3-}	K	TN	TC	IC	TOC	DOC
110	Bayou	2005	0.70	3.25	0.54	41.56	28.10	13.46	12.71
111	Man canal	2005	0.28	3.25	0.76	37.81	17.96	19.84	8.50
112	Man canal	2005	0.32	3.00	0.58	34.32	15.84	18.48	8.79
113	Man canal	2005	0.47	3.70	0.62	35.91	27.48	8.43	7.92
114	Bayou	2005	0.26	3.60	0.67	38.05	15.31	22.75	13.87
115	Bayou	2005	0.22	3.50	0.79	37.76	18.04	19.73	7.33
116	Bayou	2005	0.37	3.40	0.65	30.93	21.77	9.16	8.39
117	Man canal	2005	0.20	3.65	0.60	41.18	17.11	24.06	13.35
118	Bayou	2005	0.23	3.15	0.75	37.66	17.68	19.98	7.28
120	Man canal	2005	0.18	3.20	0.57	40.50	18.15	22.36	12.66
121	Man canal	2005	0.22	3.40	0.82	37.99	18.12	19.87	9.09
122	Swamp	2005	0.23	3.25	0.77	38.39	18.22	20.17	8.13
123	Swamp	2005	0.21	4.15	0.56	41.08	18.85	22.39	11.71
124	Swamp	2005	0.38	2.75	0.91	38.41	17.51	20.90	10.24
125	Lake	2005	0.24	3.20	0.62	37.55	17.10	20.45	9.00
127	Bayou	2005	0.28	3.57	1.03	37.22	29.77	7.45	7.01
130	Bayou	2005	0.29	3.60	1.03	37.12	29.66	7.46	6.94
133	Bayou	2005	0.27	3.60	1.04	38.05	30.15	7.90	7.10
135	Man canal	2005	0.27	3.77	0.85	50.15	32.54	17.60	16.30
137	Man canal	2005	0.14	3.40	1.27	46.43	30.26	16.16	14.21
138	Man canal	2005	0.17	3.50	0.86	36.92	27.59	9.33	7.73
139	Man canal	2005	0.26	7.77	1.25	58.22	35.54	22.68	15.91
140	Man canal	2005	0.18	4.87	1.29	44.65	28.91	15.74	14.14
141	Man canal	2005	0.16	9.20	2.46	63.23	42.87	20.36	18.94
142	Man canal	2005	0.19	3.83	0.67	49.59	33.82	15.77	13.67
144	Bayou	2005	0.32	3.80	0.82	45.61	31.77	13.84	12.38
158	Bayou	2005	1.76	4.90	1.36	34.81	21.91	12.90	10.64
162	Man canal	2005	0.33	4.37	0.98	38.35	26.33	12.03	10.93
164	Man canal	2005	2.36	3.77	1.05	38.58	26.63	11.95	11.23

Location	Type	Year	Secchi	Flow	Depth	pH	Salinity	D.O.	Ca
114	Bayou	2005	350	1.0	0.7	8.28	0.43	3.61	.
115	Bayou	2005	255	21.2	1.3	8.06	0.25	2.50	.
116	Bayou	2005	410	7.8	1.6	8.46	0.23	2.72	.
117	Man canal	2005	440	5.7	1.4	7.40	0.21	1.99	.
118	Bayou	2005	150	8.2	0.5	8.28	0.24	2.85	.
120	Man canal	2005	550	0.8	1.2	7.61	0.23	1.82	.
121	Man canal	2005	220	5.9	0.5	7.82	0.25	2.21	.
122	Swamp	2005	0	0.0	0.3	7.93	0.26	1.99	.
123	Swamp	2005	335	0.0	0.5	7.38	0.24	1.80	.
124	Swamp	2005	250	0.0	0.4	7.38	0.24	1.95	.
125	Lake	2005	345	1.3	0.7	8.41	0.23	2.13	.
127	Bayou	2005	290	11.8	2.2	8.04	0.25	2.92	.
130	Bayou	2005	370	8.4	2.9	8.06	0.25	2.74	.
133	Bayou	2005	320	1.9	0.8	8.02	0.25	2.79	.
135	Man canal	2005	0	0.0	1.4	7.17	0.24	1.41	.
137	Man canal	2005	180	3.0	1.0	7.32	0.24	2.19	.
138	Man canal	2005	230	6.3	1.2	7.96	0.23	3.00	.
139	Man canal	2005	0	0.0	0.2	6.96	0.28	0.76	.
140	Man canal	2005	0	0.0	0.4	6.91	0.21	1.38	.
141	Man canal	2005	0	0.0	0.2	6.93	0.40	0.47	.
142	Man canal	2005	460	0.0	0.9	7.55	0.25	2.99	.
144	Bayou	2005	260	2.0	0.8	7.73	0.22	2.37	.
158	Bayou	2005	20	0.0	0.2	7.27	0.13	1.75	.
162	Man canal	2005	240	21.7	0.5	7.36	0.15	2.10	.
164	Man canal	2005	420	1.0	1.3	.	.	.	.
1	Lake	2006	290	5.8	2.0	7.88	0.30	5.85	25.16
2	Swamp	2006	300	.	0.3	7.17	0.20	1.51	17.06
3	Lake	2006	270	13.9	1.1	7.77	0.20	5.21	22.22
4	Swamp	2006	240	8.1	0.5	7.35	0.20	4.86	21.75

Location	Type	Year	PO_4^{3-}	K	TN	TC	IC	TOC	DOC
1	Lake	2006	0.35	3.00	0.48	32.26	27.98	4.28	4.06
2	Swamp	2006	0.54	4.50	0.30	32.43	28.24	4.19	3.51
3	Lake	2006	0.32	2.85	0.41	30.59	24.85	5.73	5.38
4	Swamp	2006	0.23	3.00	0.48	30.82	24.75	5.99	5.37
5	Lake	2006	0.29	2.65	0.45	30.48	24.32	6.16	5.58
6	Lake	2006	0.36	3.00	0.52	31.99	25.28	6.71	5.90
8	Man canal	2006	0.81	4.05	0.38	33.45	26.48	6.98	6.30
9	Lake	2006	0.22	3.05	0.37	30.98	25.88	5.10	4.41
10	Lake	2006	0.26	3.15	0.42	31.32	25.79	5.54	4.73
11	Lake	2006	0.23	3.00	0.44	30.92	27.76	3.16	2.37
17	Man canal	2006	0.14	2.20	0.37	34.74	28.48	6.27	5.61
19	Lake	2006	0.33	2.30	0.31	31.13	27.91	3.22	2.38
20	Bayou	2006	0.33	2.30	0.27	34.05	28.14	5.91	5.47
22	Bayou	2006	0.23	2.20	0.29	33.58	26.65	6.94	6.60
23	Bayou	2006	0.20	2.15	0.29	34.05	26.84	7.22	6.75
25	Lake	2006	0.27	2.35	0.36	31.24	26.98	4.26	3.51
26	Bayou	2006	0.22	2.15	0.40	34.29	27.23	7.05	6.12
31	Man canal	2006	0.30	1.90	0.47	39.36	27.42	11.94	11.40
35	Man canal	2006	0.23	2.45	0.42	34.67	28.91	5.77	5.34
37	Swamp	2006	0.37	4.30	0.52	35.53	25.08	10.45	9.97
43	Man canal	2006	0.15	3.90	0.38	37.51	28.95	8.56	7.60
44	Man canal	2006	0.26	3.65	0.39	34.76	23.76	11.01	8.47
45	Man canal	2006	0.21	3.95	0.39	36.37	29.49	6.88	5.38
46	Man canal	2006	0.16	3.45	0.53	42.23	31.76	10.48	9.09
47	Bayou	2006	0.21	3.80	0.46	42.03	34.80	7.23	6.61
48	Man canal	2006	0.25	4.80	0.33	45.41	37.50	7.91	6.98
50	Bayou	2006	0.65	4.60	0.41	41.75	30.81	10.95	10.20
51	Man canal	2006	0.23	2.85	0.49	41.45	26.67	14.79	14.12

Location	Type	Year	Secchi	Flow	Depth	pH	Salinity	D.O.	Ca
5	Lake	2006	280	4.9	1.3	7.66	0.20	5.07	28.33
6	Lake	2006	320	119.0	0.8	7.69	0.30	4.82	22.58
8	Man canal	2006	300	12.3	0.3	7.15	0.20	2.18	19.64
9	Lake	2006	320	505.0	1.8	7.87	0.30	5.62	23.28
10	Lake	2006	320	3.9	1.3	7.86	0.30	5.25	24.81
11	Lake	2006	280	0.0	1.1	7.76	0.20	5.08	22.81
17	Man canal	2006	480	18.6	4.0	7.96	0.27	6.83	23.40
19	Lake	2006	220	3.6	0.8	7.89	0.23	5.82	20.23
20	Bayou	2006	390	11.5	4.0	8.13	0.23	6.89	24.10
22	Bayou	2006	480	0.7	1.6	7.44	0.24	5.19	21.17
23	Bayou	2006	460	14.2	2.0	7.42	0.24	5.42	19.17
25	Lake	2006	200	1.5	0.3	7.68	0.25	4.72	20.46
26	Bayou	2006	440	18.2	2.3	7.42	0.23	4.97	19.17
31	Man canal	2006	1100	0.0	2.6	7.06	0.26	3.82	17.88
35	Man canal	2006	430	0.0	1.3	7.71	0.27	2.11	21.64
37	Swamp	2006	598	11.1	1.2	6.93	0.20	2.12	24.92
43	Man canal	2006	480	1.2	1.2	7.19	0.20	4.41	24.57
44	Man canal	2006	260	3.2	1.7	7.64	0.20	5.74	20.93
45	Man canal	2006	510	0.5	3.0	6.93	0.20	2.62	25.28
46	Man canal	2006	190	0.9	1.2	6.93	0.20	1.61	26.22
47	Bayou	2006	410	0.0	1.3	7.40	0.20	5.00	25.63
48	Man canal	2006	460	5.4	0.8	7.16	0.20	6.00	26.10
50	Bayou	2006	490	0.2	2.0	6.88	0.20	1.82	18.47
51	Man canal	2006	940	0.0	1.6	6.84	0.20	1.98	14.83
52	Man canal	2006	1130	0.0	2.5	6.95	0.20	1.41	26.22
55	Man canal	2006	267	0.5	1.5	7.04	0.20	2.01	26.33
56	Bayou	2006	630	8.5	2.2	7.09	0.20	3.89	24.92
63	Lake	2006	320	7.3	1.6	8.19	0.20	5.22	17.53

Location	Type	Year	PO_4^{3-}	K	TN	TC	IC	TOC	DOC
52	Man canal	2006	0.38	4.70	0.37	45.49	34.76	10.73	10.17
55	Man canal	2006	0.24	3.50	0.47	41.29	29.85	11.43	11.05
56	Bayou	2006	0.27	3.90	0.36	40.01	30.64	9.32	8.36
63	Lake	2006	0.64	3.25	0.64	33.99	26.11	7.89	7.14
64	Bayou	2006	0.44	3.15	0.58	32.83	25.96	6.87	6.41
65	Lake	2006	0.65	2.90	0.67	33.51	26.05	7.46	6.78
66	Lake	2006	0.61	3.25	0.60	33.05	25.91	7.19	6.91
67	Bayou	2006	0.20	2.00	0.40	30.04	24.57	5.47	5.06
68	Man canal	2006	0.20	1.50	0.42	32.51	24.87	7.63	7.80
69	Lake	2006	0.84	2.80	0.60	32.36	25.93	6.43	5.83
70	Bayou	2006	0.35	2.85	0.53	30.45	23.71	6.74	6.23
71	Bayou	2006	0.27	2.65	0.60	35.92	27.74	8.18	7.40
72	Lake	2006	0.84	3.45	0.68	32.58	26.18	6.41	6.08
73	Man canal	2006	0.22	2.10	0.49	34.43	27.17	7.26	7.06
74	Bayou	2006	0.63	2.25	0.63	32.57	25.50	7.08	6.45
75	Man canal	2006	0.25	2.10	0.46	34.14	25.45	8.69	8.27
76	Man canal	2006	0.22	2.45	0.54	35.36	27.31	7.55	6.83
78	Man canal	2006	0.31	2.25	0.43	35.01	27.53	7.48	6.82
79	Bayou	2006	0.25	2.50	0.56	33.07	25.29	7.78	6.51
80	Man canal	2006	0.20	1.90	0.39	34.01	26.73	7.28	6.63
81	Man canal	2006	0.17	3.75	0.51	33.67	26.84	6.83	5.86
82	Man canal	2006	0.22	2.10	0.40	35.00	27.67	7.33	6.77
83	Man canal	2006	0.31	2.75	0.66	33.92	28.30	5.62	4.72
84	Swamp	2006	0.19	3.80	0.50	34.15	28.10	6.05	4.28
85	Man canal	2006	0.18	2.40	0.49	34.33	32.21	7.12	6.76
86	Man canal	2006	0.30	2.85	0.67	33.84	27.12	6.73	5.87
87	Bayou	2006	0.30	2.60	0.48	32.03	26.30	5.74	5.06
88	Man canal	2006	0.22	2.70	0.60	31.78	25.95	5.84	4.87

Location	Type	Year	Secchi	Flow	Depth	pH	Salinity	D.O.	Ca
64	Bayou	2006	240	6.2	0.9	7.63	0.20	3.87	17.29
65	Lake	2006	270	5.5	1.6	8.26	0.20	4.40	19.17
66	Lake	2006	320	2.4	1.2	8.60	0.20	6.67	18.82
67	Bayou	2006	525	0.0	2.1	7.20	0.20	3.99	9.78
68	Man canal	2006	400	3.1	1.3	7.27	0.20	4.36	114.39
69	Lake	2006	390	3.3	2.0	8.33	0.20	5.15	16.82
70	Bayou	2006	240	0.4	0.7	7.72	0.20	4.79	15.06
71	Bayou	2006	275	0.0	0.9	7.38	0.30	0.14	13.07
72	Lake	2006	290	2.4	1.9	8.68	0.20	6.95	19.17
73	Man canal	2006	250	1.1	1.2	7.42	0.20	3.98	21.64
74	Bayou	2006	270	4.6	0.9	8.28	0.20	4.53	16.47
75	Man canal	2006	340	.	0.3	7.33	0.20	2.65	17.29
76	Man canal	2006	385	2.1	1.0	7.04	0.30	1.41	7.55
78	Man canal	2006	315	4.9	2.5	7.46	0.20	5.40	19.52
79	Bayou	2006	340	0.0	0.8	6.88	0.20	1.61	21.87
80	Man canal	2006	535	0.0	1.4	7.33	0.20	6.73	20.70
81	Man canal	2006	515	0.0	2.2	7.07	0.20	2.83	25.16
82	Man canal	2006	230	6.3	0.7	7.19	0.20	3.40	20.93
83	Man canal	2006	190	1.0	0.7	7.32	0.20	2.00	22.11
84	Swamp	2006	305	0.0	0.6	7.22	0.20	4.48	28.68
85	Man canal	2006	200	18.3	0.9	7.41	0.20	4.65	19.76
86	Man canal	2006	250	6.5	1.9	7.46	0.20	1.94	20.11
87	Bayou	2006	300	4.3	0.5	8.12	0.20	6.62	19.99
88	Man canal	2006	280	13.7	1.1	7.88	0.20	4.95	18.23
89	Man canal	2006	340	5.6	1.1	8.06	0.20	7.27	18.23
90	Man canal	2006	400	12.2	1.4	7.85	0.20	6.30	17.41
91	Man canal	2006	300	14.1	1.6	7.84	0.20	3.13	25.04
92	Man canal	2006	280	12.0	0.8	7.26	0.20	2.98	21.75

Location	Type	Year	PO_4^{3-}	K	TN	TC	IC	TOC	DOC
89	Man canal	2006	0.21	3.40	0.68	25.13	22.74	2.39	2.06
90	Man canal	2006	0.23	2.95	0.59	27.08	24.55	2.53	2.23
91	Man canal	2006	0.19	3.90	0.52	33.63	27.29	6.33	4.56
92	Man canal	2006	0.29	2.90	0.56	32.99	28.70	4.29	3.89
93	Man canal	2006	0.33	3.15	0.66	33.56	27.93	5.63	5.32
94	Lake	2006	0.45	3.35	0.53	29.76	27.25	2.52	2.41
95	Man canal	2006	0.20	4.00	0.59	34.31	27.05	7.24	5.67
96	Lake	2006	0.56	2.45	0.46	32.30	26.52	5.78	5.10
97	Man canal	2006	0.22	3.75	0.50	32.38	26.62	5.75	5.14
98	Man canal	2006	0.24	2.85	0.55	30.11	25.28	4.84	4.67
99	Lake	2006	0.45	3.05	0.55	29.27	26.58	2.69	2.31
100	Man canal	2006	0.19	2.30	0.45	32.07	25.60	6.42	5.75
101	Bayou	2006	0.28	2.80	0.50	33.45	29.26	4.14	3.86
102	Man canal	2006	0.29	3.10	0.50	34.36	28.34	6.02	5.64
103	Swamp	2006	0.28	4.00	0.50	33.46	27.35	6.12	5.63
104	Man canal	2006	0.18	2.55	0.47	30.71	22.27	8.44	8.06
105	Bayou	2006	0.44	3.80	0.50	33.58	27.97	5.62	4.99
106	Bayou	2006	0.21	2.85	0.61	35.23	28.52	6.71	6.39
107	Man canal	2006	0.20	2.80	0.48	34.06	25.67	8.39	7.56
108	Bayou	2006	0.21	3.25	0.54	29.95	23.64	6.31	5.50
109	Bayou	2006	0.28	2.75	0.41	31.74	24.00	7.74	7.36
110	Bayou	2006	0.51	4.25	0.46	26.53	18.56	7.97	7.68
111	Man canal	2006	0.17	2.90	0.64	33.57	26.75	6.83	6.39
112	Man canal	2006	0.47	2.55	0.46	37.97	30.31	7.65	6.80
113	Man canal	2006	0.50	3.50	0.45	34.53	29.61	4.92	4.45
114	Bayou	2006	0.18	3.00	0.61	34.17	25.33	8.94	8.66
115	Bayou	2006	0.20	2.70	0.68	30.22	23.11	7.11	6.43
116	Bayou	2006	0.23	2.90	0.60	23.48	16.17	7.31	6.13

Location	Type	Year	Secchi	Flow	Depth	pH	Salinity	D.O.	Ca
93	Man canal	2006	200	0.0	1.1	7.78	0.20	2.98	25.63
94	Lake	2006	440	14.3	1.1	8.60	0.20	6.13	19.41
95	Man canal	2006	260	8.6	0.5	7.14	0.20	2.10	25.28
96	Lake	2006	420	7.9	1.2	8.60	0.20	7.42	17.65
97	Man canal	2006	435	.	0.9	7.13	0.20	2.54	25.98
98	Man canal	2006	690	0.0	1.0	7.21	0.20	2.04	20.82
99	Lake	2006	220	2.1	0.4	8.22	0.20	6.07	31.73
100	Man canal	2006	380	5.2	1.4	8.15	0.20	7.92	19.05
101	Bayou	2006	260	4.3	1.3	7.49	0.20	3.74	18.58
102	Man canal	2006	340	8.0	1.6	7.30	0.20	3.41	19.05
103	Swamp	2006	280	1.9	0.5	7.02	0.20	3.65	22.93
104	Man canal	2006	395	0.2	1.1	7.35	0.20	4.07	18.11
105	Bayou	2006	250	2.5	1.7	8.51	0.20	6.68	30.91
106	Bayou	2006	330	12.8	1.5	7.43	0.20	3.63	17.76
107	Man canal	2006	410	0.0	1.3	7.88	0.20	6.90	19.76
108	Bayou	2006	320	2.9	1.3	8.18	0.20	5.38	19.88
109	Bayou	2006	290	3.3	1.1	7.35	0.20	5.39	13.07
110	Bayou	2006	210	1.4	0.5	7.73	0.20	6.04	17.41
111	Man canal	2006	.	11.0	0.9	8.38	0.20	7.09	15.41
112	Man canal	2006	300	1.7	0.6	7.74	0.20	4.01	20.46
113	Man canal	2006	320	0.0	0.2	6.75	0.20	0.28	21.75
114	Bayou	2006	430	0.0	1.2	7.16	0.40	3.10	19.64
115	Bayou	2006	360	2.5	1.4	8.39	0.20	6.83	17.29
116	Bayou	2006	470	9.5	1.7	8.03	0.20	7.06	14.12
117	Man canal	2006	350	0.0	1.8	7.32	0.20	2.65	16.82
118	Bayou	2006	200	5.9	0.5	8.08	0.20	6.60	17.18
120	Man canal	2006	400	0.0	2.2	7.17	0.20	1.80	19.88
121	Man canal	2006	300	1.4	0.6	7.00	0.20	2.15	18.82

Location	Type	Year	PO_4^{3-}	K	TN	TC	IC	TOC	DOC
117	Man canal	2006	0.31	2.75	0.63	36.40	25.53	10.87	10.58
118	Bayou	2006	0.68	2.00	0.59	25.48	18.12	7.36	6.68
120	Man canal	2006	0.16	2.45	0.34	32.19	25.22	6.97	5.74
121	Man canal	2006	0.29	2.55	0.87	29.37	23.81	5.56	4.79
122	Swamp	2006	0.28	3.40	1.72	33.48	27.68	5.81	5.08
123	Swamp	2006	0.34	2.10	0.37	18.84	13.47	5.37	4.09
124	Swamp	2006	0.26	3.15	0.86	32.12	25.28	7.06	6.31
125	Lake	2006	0.22	2.70	0.60	30.76	23.40	7.36	6.82
127	Bayou	2006	0.32	3.25	1.78	34.35	28.53	5.82	5.28
130	Bayou	2006	0.28	3.05	1.83	33.06	28.22	4.84	4.22
133	Bayou	2006	0.19	3.30	1.47	22.45	16.49	5.96	5.09
135	Man canal	2006	0.14	4.85	0.82	43.24	29.19	14.06	11.35
137	Man canal	2006	0.29	5.35	1.99	38.80	28.53	10.27	8.29
138	Man canal	2006	0.22	3.50	1.08	35.26	28.83	6.44	5.83
139	Man canal	2006	0.14	3.95	1.04	41.72	28.16	13.56	11.56
140	Man canal	2006	0.23	3.90	1.23	41.42	27.44	13.98	13.31
141	Man canal	2006	0.19	4.80	1.11	36.26	26.50	9.77	9.21
142	Man canal	2006	0.16	4.10	0.88	38.93	30.30	8.63	8.38
144	Bayou	2006	0.41	4.00	1.09	37.75	31.26	6.49	6.13

Location	Type	Year	Secchi	Flow	Depth	pH	Salinity	D.O.	Ca
122	Swamp	2006	180	0.0	0.2	8.18	0.22	8.72	32.33
123	Swamp	2006	370	3.8	1.0	7.23	0.20	2.33	7.55
124	Swamp	2006	180	0.0	0.2	8.34	0.22	9.54	33.64
125	Lake	2006	230	6.9	0.4	8.40	0.22	9.19	35.44
127	Bayou	2006	410	17.4	1.3	7.83	0.22	6.19	35.63
130	Bayou	2006	550	20.1	1.5	7.87	0.22	6.50	35.49
133	Bayou	2006	460	21.9	1.7	7.77	0.22	6.19	37.43
135	Man canal	2006	363	2.3	0.9	7.48	0.68	3.38	41.12

Location	Type	Year	Secchi	Flow	Depth	pH	Salinity	D.O.	Ca
137	Man canal	2006	320	3.6	0.6	7.59	1.66	4.27	59.08
138	Man canal	2006	320	3.1	0.8	7.66	0.22	4.70	32.14
139	Man canal	2006	0	0.0	0.2	6.97	0.29	2.35	30.92
140	Man canal	2006	0	0.0	0.5	6.96	0.26	0.87	29.66
141	Man canal	2006	145	0.0	0.3	7.45	0.51	6.12	31.07
142	Man canal	2006	400	2.6	0.5	7.49	0.68	4.64	39.08
144	Bayou	2006	280	0.0	0.6	7.71	0.21	4.76	27.67

APPENDIX B: SOIL QUALITY DATA

Values shown are averages for each location.

Location	Year	Ca	pH	P	K	Organic Matter	C	N
1	2005	3585.20	7.45	473.68	210.27	3.06	.	.
2	2005	3573.56	7.38	318.40	211.84	1.92	.	.
3	2005	2350.28	7.33	356.86	129.83	2.33	.	.
4	2005	2419.38	7.04	360.97	117.72	2.33	.	.
5	2005	3207.29	7.09	62.24	193.33	3.56	.	.
6	2005	1996.08	7.36	61.87	109.19	2.18	.	.
8	2005	3107.25	7.44	37.20	185.37	2.64	.	.
9	2005	3988.24	7.01	62.11	281.51	5.89	.	.
10	2005	4034.29	6.88	54.31	282.59	6.67	.	.
11	2005	4611.18	6.58	51.35	354.70	6.43	.	.
17	2005	2609.42	7.78	46.28	129.54	1.76	.	.
19	2005	4220.01	7.38	34.56	334.32	3.09	.	.
20	2005	4089.55	7.49	42.20	258.23	4.10	.	.
22	2005	4313.04	7.11	77.32	339.45	5.47	.	.
23	2005	4397.59	6.81	109.54	274.39	6.34	.	.
25	2005	4578.04	7.35	29.14	279.30	2.42	.	.
26	2005	5707.25	6.70	86.37	218.14	7.85	.	.
31	2005	6035.51	6.61	51.15	316.16	7.14	.	.
35	2005	5000.94	6.83	66.64	256.68	6.55	.	.
37	2005	4732.75	6.58	71.22	315.49	5.49	.	.
43	2005	5194.62	6.60	52.55	251.96	7.31	.	.
44	2005	3581.65	7.66	40.00	172.60	5.26	.	.
45	2005	4574.86	7.14	43.56	271.88	4.32	.	.
46	2005	4365.76	6.72	113.59	271.00	6.83	.	.
47	2005	5125.51	6.55	91.99	263.86	7.12	.	.
48	2005	4959.18	6.76	87.30	270.22	7.70	.	.
50	2005	5011.92	6.47	73.99	316.92	6.85	.	.
51	2005	6665.28	6.24	34.61	266.89	7.46	.	.
52	2005	5946.02	6.68	44.25	253.90	7.52	.	.
55	2005	5125.78	6.95	48.19	347.02	4.20	.	.
56	2005	5027.69	6.67	45.02	389.60	3.54	.	.
58	2005	9241.62	6.99	55.34	384.42	6.87	.	.
63	2005	3840.53	7.53	12.08	330.12	2.20	.	.
64	2005	3814.92	6.97	57.35	206.02	6.07	.	.
65	2005	4394.23	7.56	25.40	350.95	2.69	.	.
66	2005	3181.54	7.81	25.32	195.57	1.75	.	.

Location	Year	Ca	pH	P	K	Organic Matter	C	N
67	2005	7956.04	6.67	80.10	344.28	7.06	.	.
68	2005	8432.04	6.38	36.16	289.22	8.14	.	.
69	2005	4374.92	7.66	15.06	313.36	2.47	.	.
70	2005	3023.92	7.54	40.54	191.84	2.67	.	.
71	2005	5809.83	6.76	48.66	308.19	6.15	.	.
72	2005	4789.28	7.57	22.17	345.72	2.73	.	.
73	2005	7167.67	7.08	20.14	329.33	6.23	.	.
74	2005	3754.21	7.09	27.63	253.40	3.07	.	.
75	2005	6355.23	6.28	54.15	286.83	8.42	.	.
76	2005	4732.56	6.95	32.33	362.85	3.90	.	.
77	2005	5098.41	6.46	39.37	355.48	6.18	.	.
78	2005	5079.71	6.33	43.68	375.64	4.49	.	.
79	2005	4505.70	7.05	58.11	255.87	4.87	.	.
80	2005	5141.81	6.48	29.20	346.42	6.58	.	.
81	2005	5079.29	6.45	33.55	322.27	3.20	.	.
82	2005	4597.01	6.45	63.48	305.82	5.12	.	.
83	2005	5048.45	6.87	53.75	347.91	3.28	.	.
84	2005	5243.10	6.61	63.43	327.18	5.09	.	.
85	2005	4936.51	6.99	62.40	341.88	5.74	.	.
86	2005	6090.68	6.47	99.72	330.34	6.14	.	.
87	2005	2280.37	6.92	53.29	98.19	4.23	.	.
88	2005	2392.20	6.98	57.68	106.96	3.57	.	.
89	2005	5691.11	7.11	45.93	316.31	6.77	.	.
90	2005	5699.43	7.40	50.13	362.63	5.07	.	.
91	2005	5283.06	6.94	35.57	325.81	6.08	.	.
92	2005	5139.86	6.89	32.59	350.10	4.78	.	.
93	2005	4956.60	7.67	26.31	384.29	2.36	.	.
94	2005	2236.38	7.33	33.87	158.06	1.61	.	.
95	2005	5599.78	6.82	20.71	415.07	3.73	.	.
96	2005	5605.39	7.61	21.44	279.94	2.43	.	.
97	2005	5242.74	6.69	38.71	365.03	5.40	.	.
98	2005	4683.44	6.98	25.47	394.05	3.31	.	.
99	2005	5223.95	7.49	15.72	303.87	2.77	.	.
100	2005	5664.67	7.46	15.50	366.37	3.70	.	.
101	2005	5424.95	7.02	22.28	355.91	3.48	.	.
102	2005	7068.35	7.12	51.87	305.03	8.81	.	.
103	2005	5202.13	6.65	58.67	337.68	5.66	.	.
104	2005	4532.48	6.96	21.35	359.25	3.13	.	.
105	2005	2365.86	7.44	31.73	128.56	2.79	.	.
106	2005	6757.75	6.86	28.04	382.06	5.24	.	.

Location	Year	Ca	pH	P	K	Organic Matter	C	N
107	2005	6331.68	6.64	17.02	392.08	5.83	.	.
108	2005	2675.68	7.51	51.41	135.35	1.73	.	.
109	2005	4512.74	7.24	36.97	285.51	3.64	.	.
110	2005	3173.54	7.84	35.96	115.25	1.97	.	.
111	2005	2677.43	7.57	328.98	139.06	1.69	.	.
112	2005	2767.78	7.47	350.69	157.47	1.75	.	.
113	2005	3385.90	7.36	43.75	185.63	3.11	.	.
114	2005	5514.92	6.38	31.09	364.42	4.84	.	.
115	2005	1763.41	7.59	290.70	79.23	1.33	.	.
116	2005	2137.13	7.75	46.41	79.04	0.86	.	.
117	2005	4377.45	6.97	24.32	338.66	3.07	.	.
118	2005	2309.21	7.59	291.14	108.99	1.70	.	.
120	2005	5270.17	6.83	433.79	380.16	5.04	.	.
121	2005	6575.46	6.58	407.92	412.87	6.92	.	.
122	2005	4990.16	7.04	696.25	308.05	5.83	.	.
123	2005	5822.68	6.88	576.49	428.05	4.72	.	.
124	2005	5782.90	6.98	877.56	332.89	6.29	.	.
125	2005	5271.80	6.97	456.55	364.03	3.73	.	.
127	2005	2534.03	8.11	254.50	94.46	1.08	.	.
130	2005	3046.95	8.01	284.02	119.65	1.28	.	.
133	2005	1790.45	8.14	204.90	61.01	0.66	.	.
135	2005	4920.78	7.37	452.16	243.85	4.73	.	.
137	2005	4385.41	7.08	429.45	268.21	3.92	.	.
138	2005	2988.26	7.66	284.32	167.79	1.80	.	.
139	2005	4987.01	6.67	525.75	339.96	5.65	.	.
140	2005	5168.43	6.24	723.73	344.90	5.90	.	.
141	2005	5299.60	6.73	616.75	366.72	5.87	.	.
142	2005	5023.20	6.50	394.82	399.09	4.74	.	.
144	2005	2782.92	7.36	348.03	174.41	2.43	.	.
158	2005	5798.12	6.53	178.30	443.21	6.64	.	.
162	2005	1592.74	7.13	277.86	92.90	1.78	.	.
164	2005	6126.05	7.53	257.12	430.66	2.49	.	.
1	2006	4434.26	7.72	46.08	184.80	3.03	1.66	0.19
2	2006	2684.26	7.28	38.33	113.79	2.54	1.14	0.12
3	2006	2873.04	7.39	69.51	139.68	2.92	1.49	0.13
4	2006	2151.11	7.57	58.53	82.95	1.28	0.71	0.08
5	2006	3397.26	7.43	61.99	165.10	3.26	1.72	0.18
6	2006	2592.65	7.33	70.94	108.69	3.50	1.41	0.12
8	2006	2509.53	7.44	55.94	99.73	1.87	1.02	0.10
9	2006	4743.55	7.20	61.10	257.59	6.73	3.70	0.36

Location	Year	Ca	pH	P	K	Organic Matter	C	N
10	2006	4428.63	6.94	43.29	257.85	6.15	3.14	0.34
11	2006	4403.41	6.84	42.46	271.24	6.72	4.27	0.45
17	2006	4862.39	7.53	50.67	265.41	4.13	2.28	0.25
19	2006	4669.77	7.29	31.68	395.98	3.36	1.98	0.21
20	2006	6033.94	7.52	24.69	356.48	3.71	2.53	0.30
22	2006	5787.37	6.72	65.29	334.70	7.11	8.63	0.59
23	2006	5342.24	6.95	54.64	329.03	6.12	5.72	0.50
25	2006	6437.92	7.59	22.21	332.67	2.92	1.62	0.18
26	2006	5390.77	7.36	33.62	443.27	4.10	3.63	0.36
31	2006	6942.99	6.69	39.89	431.63	8.41	14.20	0.89
35	2006	5638.62	7.29	44.23	373.56	5.55	4.01	0.33
37	2006	5689.78	6.57	42.21	399.40	7.01	6.87	0.59
43	2006	6429.99	7.32	20.73	517.61	4.92	3.50	0.24
44	2006	4865.27	7.21	37.84	202.25	5.66	5.00	0.33
45	2006	6146.63	6.46	37.48	389.66	6.36	8.50	0.60
46	2006	6220.41	7.11	34.44	440.72	7.42	9.18	0.60
47	2006	5318.31	7.01	50.75	312.41	6.17	6.06	0.57
48	2006	5420.59	6.96	52.89	299.11	5.52	5.56	0.42
50	2006	6319.57	6.58	60.27	402.24	6.85	10.05	0.75
51	2006	7121.16	6.23	32.79	275.27	7.60	18.55	1.04
52	2006	6464.21	6.73	37.90	310.52	7.83	16.20	1.21
55	2006	6917.38	6.93	54.68	388.73	7.23	9.41	0.71
56	2006	6352.85	6.82	41.70	377.00	7.62	8.18	0.65
63	2006	4194.07	7.59	19.40	378.44	2.60	1.78	0.23
64	2006	3798.88	7.55	29.92	248.66	2.58	1.74	0.19
65	2006	4578.94	7.73	10.54	403.99	2.41	2.52	0.35
66	2006	5519.34	7.57	80.38	426.63	3.30	2.39	0.29
67	2006	6087.29	6.98	46.97	336.61	6.24	6.63	0.54
68	2006	6442.70	7.10	24.65	461.64	5.51	5.10	0.45
69	2006	5171.22	7.68	9.79	382.65	2.87	2.14	0.28
70	2006	2978.78	6.76	52.77	179.15	4.45	2.39	0.28
71	2006	6523.80	6.62	85.05	294.27	7.23	13.15	0.75
72	2006	5246.70	7.75	9.05	390.88	3.15	2.25	0.24
73	2006	6226.74	7.18	23.17	395.09	6.51	4.92	0.35
74	2006	1705.54	6.78	49.44	81.43	1.86	0.74	0.09
75	2006	7311.29	6.11	101.45	318.89	7.37	16.15	1.04
76	2006	5773.43	6.84	18.20	449.11	5.00	4.26	0.41
78	2006	6394.53	6.82	23.71	481.78	5.45	5.47	0.47
79	2006	4755.74	7.25	48.41	298.29	4.71	2.30	0.25
80	2006	5954.72	6.46	37.75	421.91	6.57	10.68	0.94

Location	Year	Ca	pH	P	K	Organic Matter	C	N
81	2006	6362.92	6.76	21.98	418.64	6.25	6.04	0.47
82	2006	5605.01	6.67	31.10	409.21	5.74	6.08	0.60
83	2006	5722.57	7.29	25.76	423.61	4.96	2.98	0.28
84	2006	6142.99	6.43	20.65	405.17	7.25	7.06	0.63
85	2006	4988.58	7.25	22.32	304.37	4.79	3.05	0.29
86	2006	6317.43	7.22	28.37	483.20	5.10	4.58	0.37
87	2006	2625.10	6.96	54.68	129.90	3.39	1.50	0.14
88	2006	2720.10	6.85	44.11	135.83	3.58	1.91	0.17
89	2006	5630.69	7.34	38.08	353.62	6.19	4.26	0.30
90	2006	6251.37	7.58	26.70	433.97	3.91	2.46	0.20
91	2006	5697.84	7.20	40.31	479.66	5.24	3.16	0.32
92	2006	5657.56	7.13	19.57	456.08	4.55	3.21	0.32
93	2006	5414.36	7.55	25.47	422.81	4.02	2.14	0.24
94	2006	5565.38	7.60	14.18	406.98	3.03	1.87	0.24
95	2006	6761.59	6.84	20.88	426.32	5.96	4.23	0.47
96	2006	8039.19	7.81	8.65	410.00	3.37	2.15	0.25
97	2006	6080.73	7.10	25.81	451.64	4.72	3.74	0.41
98	2006	5526.53	7.04	16.94	441.43	4.07	3.00	0.35
99	2006	2985.81	7.34	25.33	168.78	2.39	1.11	0.12
100	2006	5674.66	7.31	18.67	401.62	5.00	3.11	0.27
101	2006	5442.60	7.49	15.39	371.58	3.75	2.14	0.26
102	2006	6812.61	6.96	63.83	375.81	7.29	7.50	0.49
103	2006	5312.19	7.31	77.21	296.80	5.28	2.74	0.30
104	2006	5832.38	6.80	16.34	385.19	5.88	4.88	0.37
105	2006	3640.62	7.32	28.54	211.36	3.65	1.77	0.17
106	2006	6325.05	7.44	17.14	391.40	5.86	3.85	0.29
107	2006	5210.00	7.52	32.43	437.30	3.83	2.85	0.32
108	2006	2795.37	7.66	53.53	129.37	1.90	0.83	0.10
109	2006	4497.75	7.59	29.02	290.64	3.96	1.63	0.21
110	2006	2665.90	7.60	52.91	106.37	1.45	0.57	0.08
111	2006	2863.44	7.75	52.80	127.18	1.47	0.82	0.09
112	2006	3992.71	7.89	49.58	124.23	1.57	0.92	0.10
113	2006	3984.52	7.46	67.17	193.72	4.39	1.91	0.20
114	2006	6142.90	6.79	21.84	394.21	5.98	4.56	0.35
115	2006	2627.49	7.89	61.61	94.84	0.66	0.36	0.05
116	2006	3404.59	7.62	49.12	165.83	1.70	1.02	0.11
117	2006	4018.29	7.29	16.22	310.06	3.32	1.85	0.22
118	2006	2925.66	7.59	54.44	124.13	1.48	0.86	0.10
120	2006	5423.98	7.35	14.79	433.44	3.26	2.13	0.23
121	2006	5729.16	6.69	41.01	394.38	6.30	6.12	0.50

Location	Year	Ca	pH	P	K	Organic Matter	C	N
122	2006	5299.77	7.23	57.31	298.34	5.47	3.26	0.31
123	2006	5733.81	7.32	23.47	423.21	4.00	3.27	0.35
124	2006	6133.85	7.25	32.29	339.56	6.10	3.22	0.28
125	2006	5134.20	7.24	16.17	423.32	4.44	2.61	0.33
127	2006	2514.90	7.88	55.33	112.58	1.05	0.65	0.08
130	2006	2753.49	7.91	53.34	117.89	1.30	0.76	0.09
133	2006	2758.51	7.98	58.08	97.73	0.93	0.58	0.08
135	2006	4666.00	7.06	28.63	363.06	4.64	2.66	0.23
137	2006	3404.07	7.31	24.25	298.29	2.81	1.31	0.15
138	2006	3848.28	7.75	32.17	262.51	1.85	0.91	0.14
139	2006	6129.97	6.44	26.22	460.77	6.97	5.56	0.51
140	2006	5891.77	6.38	41.04	415.08	7.59	6.78	0.57
141	2006	5830.00	6.90	30.40	438.71	6.57	4.28	0.40
142	2006	5397.18	6.92	20.34	515.67	6.40	4.35	0.29
144	2006	3614.02	7.27	25.77	259.58	3.06	1.59	0.18

APPENDIX C: PERCENT PLANT COVERAGE DATA

Values shown are averages for each location.

Site	Year	*Lemna* spp.	*Hydrocotyle ranunculoides*	*Spirodela polyrhiza*	*Eichhornia crassipes*	*Limnobium spongia*
1	2005	0.03874	0	0	0.11674	0.00062
2	2005	0.01368	0.00802	0	0.82202	0
3	2005	0.0014	0	0.00004	0	0.0002
4	2005	0.03514	0	0.00198	0.41892	0
5	2005	0	0	0	0	0
6	2005	0	0	0	0	0
8	2005	0.0001	0	0	0	0
9	2005	0	0	0	0	0
10	2005	0	0	0	0	0
11	2005	0	0	0	0	0
17	2005	0	0	0	0.0546	0
19	2005	0	0	0	0	0
20	2005	0	0	0	0	0
22	2005	0.0032	0	0	0.05436	0
23	2005	0.002	0	0.00014	0.02968	0.0025
25	2005	0	0	0	0	0
26	2005	0.0458	0	0.00014	0.03448	0
31	2005	0.026	0	0.00038	0.02146	0.0016
35	2005	0.00518	0	0.00056	0.06698	0.00638
37	2005	0.00726	0	0.00024	0.092	0
43	2005	0.00528	0	0.00218	0.04166	0
44	2005	0	0	0	0	0

Site	Year	*Cyperus* spp.	*Alternanthera philoxeroides*	*Paspalum fluitans*	*Myriophyllum spicatum*	*Hydrilla verticillata*
1	2005	0	0	0	0	0
2	2005	0.00626	0.01736	0	0	0.0032
3	2005	0	0	0	0	0
4	2005	0.00724	0	0	0	0
5	2005	0	0	0	0.01304	0
6	2005	0	0	0	0	0
8	2005	0	0.04512	0	0	0.01702
9	2005	0	0	0	0	0
10	2005	0	0	0	0	0
11	2005	0	0	0	0	0
17	2005	0	0.01356	0	0	0.00102
19	2005	0	0	0	0	0
20	2005	0	0	0	0	0
22	2005	0	0.00084	0	0	0.0011
23	2005	0	0.03462	0	0	0.00682
25	2005	0	0	0	0	0
26	2005	0	0.04268	0	0	0
31	2005	0	0.01004	0	0	0.00074
35	2005	0.00338	0.01168	0	0	0.00146
37	2005	0.01	0	0	0	0
43	2005	0	0.04352	0	0	0
44	2005	0	0	0	0	0.00182
45	2005	0	0.0014	0	0	0
46	2005	0	0	0	0	0
47	2005	0.03042	0.00498	0	0	0.00108
48	2005	0	0	0.00418	0	0

Site	Year	*Nelumbo lutea*	*Cabomba caroliniana*	*Ceratophyllum demersum*	*Salvinia minima*	*Potamogeton* spp.
1	2005	0	0	0	0.0423	0
2	2005	0	0	0	0.05482	0
3	2005	0	0	0	0.005	0
4	2005	0.37014	0	0	0.00116	0
5	2005	0	0	0	0	0
6	2005	0	0	0	0	0
8	2005	0	0.02776	0	0.00046	0
9	2005	0	0	0	0	0
10	2005	0	0	0	0	0
11	2005	0	0	0	0	0
17	2005	0	0	0	0.01278	0
19	2005	0	0	0	0	0
20	2005	0	0	0	0	0
22	2005	0	0.00072	0.00336	0.021	0.0412
23	2005	0	0	0.00694	0.02786	0
25	2005	0	0	0	0	0
26	2005	0	0	0	0.13808	0
31	2005	0	0.1263	0	0.14974	0
35	2005	0	0	0	0.20864	0
37	2005	0	0	0	0.1944	0
43	2005	0	0	0.02216	0.06892	0
44	2005	0	0	0	0	0.00694
45	2005	0	0	0	0.06582	0
46	2005	0	0	0	0	0
47	2005	0	0	0.00468	0.02476	0
48	2005	0	0	0	0.07626	0

Site	Year	*Ludwigia peploides*	*Utricularia vulgaris*	*Azolla caroliniana*	*Salvinia molesta*	*Najas guadalupensis*
1	2005	0	0	.	.	.
2	2005	0	0	.	.	.
3	2005	0	0	.	.	.
4	2005	0	0	.	.	.
5	2005	0	0	.	.	.
6	2005	0	0	.	.	.
8	2005	0	0	.	.	.
9	2005	0	0	.	.	.
10	2005	0	0	.	.	.
11	2005	0	0	.	.	.
17	2005	0	0	.	.	.
19	2005	0	0	.	.	.
20	2005	0	0	.	.	.
22	2005	0	0	.	.	.
23	2005	0	0	.	.	.
25	2005	0	0	.	.	.
26	2005	0	0	.	.	.
31	2005	0	0	.	.	.
35	2005	0	0	.	.	.
37	2005	0	0	.	.	.
43	2005	0	0	.	.	.
44	2005	0	0	.	.	.
45	2005	0	0	.	.	.
46	2005	0	0	.	.	.
47	2005	0	0	.	.	.
48	2005	0	0	.	.	.

Site	Year	*Lemna* spp.	*Hydrocotyle ranunculoides*	*Spirodela polyrhiza*	*Eichhornia crassipes*	*Limnobium spongia*
45	2005	0.0178	0	0.00624	0.03126	0
46	2005	0	0	0	0	0
47	2005	0.00142	0	0.00658	0.11562	0
48	2005	0.00294	0	0.00246	0.01606	0
50	2005	0.01188	0	0.00428	0.10172	0
51	2005	0.00934	0	0.00418	0	0.0163
52	2005	0.00412	0	0.0028	0.0902	0.03944
55	2005	0.00928	0	0.00778	0.0126	0.01466
56	2005	0.00482	0	0.00224	0.00662	0.03244
58	2005	0.01092	0	0.00144	0	0
63	2005	0	0	0	0	0
64	2005	0.00404	0	0	0.12848	0
65	2005	0	0	0	0	0
66	2005	0	0	0	0	0
67	2005	0.01852	0	0.00902	0.31892	0.07638
68	2005	0.01418	0	0.03274	0.05002	0.7093
69	2005	0	0	0	0	0
70	2005	0.02442	0	0.06	0.06	0
71	2005	0	0	0	0	0
72	2005	0	0	0	0	0
73	2005	0.006	0	0.01194	0.0165	0
74	2005	0	0	0	0	0
75	2005	0.3227	0	0.27732	0.21782	0
76	2005	0.00018	0	0.00362	0	0
77	2005	0.00072	0	0.00066	0.03436	0.05464
78	2005	0.00444	0	0.04382	0.23734	0.1685

Site	Year	*Cyperus* spp.	*Alternanthera philoxeroides*	*Paspalum fluitans*	*Myriophyllum spicatum*	*Hydrilla verticillata*
50	2005	0	0	0	0	0
51	2005	0	0	0	0	0.0637
52	2005	0.01514	0.01474	0	0	0.02716
55	2005	0	0	0	0	0.18712
56	2005	0	0	0	0	0.15836
58	2005	0	0	0	0	0.18934
63	2005	0	0	0	0	0
64	2005	0	0	0	0	0
65	2005	0	0	0	0	0
66	2005	0	0	0	0	0
67	2005	0.03662	0.0057	0	0	0.0137
68	2005	0.10036	0.02226	0	0	0
69	2005	0	0	0	0	0
70	2005	0	0	0	0	0
71	2005	0	0	0	0	0
72	2005	0	0	0	0	0
73	2005	0	0	0	0	0.00102
74	2005	0	0	0	0	0
75	2005	0	0	0	0	0
76	2005	0	0	0.00904	0	0.0012
77	2005	0.00516	0.01416	0	0	0.00108
78	2005	0.0292	0.03864	0.0013	0	0
79	2005	0	0	0	0	0.00564
80	2005	0.00778	0.00544	0	0	0
81	2005	0	0	0	0	0
82	2005	0.06514	0.03702	0	0	0.00068

Site	Year	*Nelumbo lutea*	*Cabomba caroliniana*	*Ceratophyllum demersum*	*Salvinia minima*	*Potamogeton* spp.
50	2005	0	0	0	0.13636	0
51	2005	0	0	0.08474	0.15794	0
52	2005	0	0	0.00994	0.04522	0
55	2005	0	0	0	0.18534	0
56	2005	0	0	0	0.03542	0
58	2005	0	0.00656	0.06102	0.00052	0
63	2005	0	0	0	0	0
64	2005	0	0	0	0.00374	0
65	2005	0	0	0	0	0
66	2005	0	0	0	0	0
67	2005	0	0	0.00218	0.39972	0
68	2005	0	0	0	0.03818	0
69	2005	0	0	0	0	0
70	2005	0	0	0	0.12136	0
71	2005	0	0	0	0	0
72	2005	0	0	0	0	0
73	2005	0	0.00404	0.00388	0.00802	0
74	2005	0	0	0	0	0
75	2005	0	0	0	0.14784	0
76	2005	0	0	0.01604	0.06796	0
77	2005	0	0	0	0.55088	0
78	2005	0	0	0	0.48578	0
79	2005	0	0	0.0017	0.20642	0
80	2005	0	0	0	0.16416	0
81	2005	0	0	0	0.28526	0
82	2005	0	0	0	0.20484	0

Site	Year	*Ludwigia peploides*	*Utricularia vulgaris*	*Azolla caroliniana*	*Salvinia molesta*	*Najas guadalupensis*
50	2005	0	0	.	.	.
51	2005	0	0	.	.	.
52	2005	0	0.00004	.	.	.
55	2005	0	0	.	.	.
56	2005	0	0	.	.	.
58	2005	0	0	.	.	.
63	2005	0	0	.	.	.
64	2005	0	0	.	.	.
65	2005	0	0	.	.	.
66	2005	0	0	.	.	.
67	2005	0	0	.	.	.
68	2005	0	0	.	.	.
69	2005	0	0	.	.	.
70	2005	0	0	.	.	.
71	2005	0	0	.	.	.
72	2005	0	0	.	.	.
73	2005	0	0	.	.	.
74	2005	0	0	.	.	.
75	2005	0	0	.	.	.
76	2005	0.05818	0	.	.	.
77	2005	0.00116	0	.	.	.
78	2005	0	0	.	.	.
79	2005	0	0	.	.	.
80	2005	0	0	.	.	.
81	2005	0	0	.	.	.
82	2005	0	0	.	.	.

Site	Year	*Lemna* spp.	*Hydrocotyle ranunculoides*	*Spirodela polyrhiza*	*Eichhornia crassipes*	*Limnobium spongia*
79	2005	0.0011	0	0.0108	0.04076	0.00212
80	2005	0.00562	0	0.23272	0.0751	0.37838
81	2005	0.00806	0	0.0101	0.01342	0.01722
82	2005	0.01128	0	0.00238	0.11858	0.00374
83	2005	0.00396	0	0.01634	0.08348	0
84	2005	0.0022	0	0.00044	0.12736	0
85	2005	0.00874	0	0.01566	0.2861	0.22926
86	2005	0.00028	0	0.00244	0.0786	0.00128
87	2005	0.00006	0	0.00056	0	0
88	2005	0.00024	0	0.00008	0	0
89	2005	0.00026	0	0.00022	0	0
90	2005	0.00092	0	0.0041	0	0.00084
91	2005	0.01504	0	0.04842	0.03526	0.03236
92	2005	0.0185	0	0.0094	0.05182	0.13166
93	2005	0.0033	0	0.01732	0.00406	0.00644
94	2005	0	0	0	0	0
95	2005	0.01184	0	0.01556	0.09806	0
96	2005	0	0	0	0	0
97	2005	0	0	0.0659	0.0433	0.0289
98	2005	0.00206	0	0.0009	0	0.09624
99	2005	0	0	0	0	0
100	2005	0	0	0.00006	0	0
101	2005	0.00326	0	0.00196	0.00768	0.00688
102	2005	0.00614	0	0.02096	0.00456	0
103	2005	0.00202	0	0.00744	0.17426	0.01008
104	2005	0	0	0.00174	0.02424	0

Site	Year	*Cyperus* spp.	*Alternanthera philoxeroides*	*Paspalum fluitans*	*Myriophyllum spicatum*	*Hydrilla verticillata*
83	2005	0	0	0	0	0.01242
84	2005	0.00084	0	0.0149	0	0
85	2005	0	0	0	0	0
86	2005	0	0	0	0	0
87	2005	0	0	0	0	0
88	2005	0	0	0	0	0
89	2005	0	0	0	0	0.01554
90	2005	0	0	0.02656	0	0.01106
91	2005	0	0	0	0	0.01292
92	2005	0	0	0.01848	0	0
93	2005	0	0	0	0	0.06298
94	2005	0	0	0	0	0
95	2005	0.01896	0	0.01364	0	0.33182
96	2005	0	0	0	0	0
97	2005	0	0.00046	0.01282	0	0.00004
98	2005	0	0	0	0	0.0213
99	2005	0	0	0	0	0
100	2005	0	0	0	0	0.01264
101	2005	0.00272	0	0	0	0
102	2005	0.04802	0	0	0	0.00356
103	2005	0	0	0	0	0.00144
104	2005	0	0	0.00062	0	0
105	2005	0	0	0	0	0
106	2005	0	0	0	0	0.00238
107	2005	0	0	0	0	0.00152
108	2005	0	0	0	0	0

site	Year	*Nelumbo lutea*	*Cabomba caroliniana*	*Ceratophyllum demersum*	*Salvinia minima*	*Potamogeton* spp.
83	2005	0	0	0	0.25532	0
84	2005	0	0	0	0.85412	0
85	2005	0	0	0	0.25602	0
86	2005	0	0	0	0.21852	0
87	2005	0	0	0	0.00286	0
88	2005	0	0	0.02212	0.00166	0
89	2005	0	0	0	0.00502	0
90	2005	0	0	0	0.05086	0
91	2005	0	0	0.00562	0.08394	0
92	2005	0	0	0	0.21922	0
93	2005	0	0	0	0.21284	0
94	2005	0	0	0	0	0
95	2005	0	0.03762	0	0.19334	0
96	2005	0	0	0	0	0
97	2005	0	0	0	0.8414	0
98	2005	0	0	0.00742	0.34512	0
99	2005	0	0	0	0	0
100	2005	0	0	0	0.00246	0
101	2005	0	0	0.02454	0.0456	0
102	2005	0	0	0	0.40912	0
103	2005	0	0	0	0.73148	0
104	2005	0	0	0	0.06812	0
105	2005	0	0	0	0	0
106	2005	0	0	0	0.007	0
107	2005	0	0	0	0.40066	0
108	2005	0	0	0	0.00528	0

site	Year	*Ludwigia peploides*	*Utricularia vulgaris*	*Azolla caroliniana*	*Salvinia molesta*	*Najas guadalupensis*
83	2005	0	0	.	.	.
84	2005	0	0	.	.	.
85	2005	0.0397	0	.	.	.
86	2005	0	0	.	.	.
87	2005	0	0	.	.	.
88	2005	0	0	.	.	.
89	2005	0	0	.	.	.
90	2005	0	0	.	.	.
91	2005	0	0	.	.	.
92	2005	0	0	.	.	.
93	2005	0	0	.	.	.
94	2005	0	0	.	.	.
95	2005	0	0	.	.	.
96	2005	0	0	.	.	.
97	2005	0	0	.	.	.
98	2005	0	0	.	.	.
99	2005	0	0	.	.	.
100	2005	0	0	.	.	.
101	2005	0	0	.	.	.
102	2005	0	0	.	.	.
103	2005	0	0	.	.	.
104	2005	0	0	.	.	.
105	2005	0	0	.	.	.
106	2005	0	0	.	.	.
107	2005	0	0	.	.	.
108	2005	0	0	.	.	.

Site	Year	*Lemna* spp.	*Hydrocotyle ranunculoides*	*Spirodela polyrhiza*	*Eichhornia crassipes*	*Limnobium spongia*
105	2005	0	0	0	0	0
106	2005	0.0001	0	0.00042	0	0
107	2005	0	0	0.00966	0	0.05142
108	2005	0.00148	0	0.001	0	0
109	2005	0.00228	0	0.0017	0.0209	0.003
110	2005	0	0	0	0	0
111	2005	0.00428	0	0.00052	0	0.00254
112	2005	0	0	0.02524	0	0
113	2005	0.39156	0	0.00278	0	0.00174
114	2005	0.00048	0	0.02448	0.00566	0
115	2005	0.00086	0	0.03382	0.01206	0.00188
116	2005	0	0	0	0	0
117	2005	0	0	0	0	0
118	2005	0.00408	0	0.00038	0	0
120	2005	0.00058	0	0.00134	0	0.00262
121	2005	0.00028	0	0.00076	0.005	0.00198
122	2005	0.6277	0	0	0.08948	0.16602
123	2005	0.14128	0	0.00582	0	0.01972
124	2005	0.27652	0	0.00348	0.3032	0.0168
125	2005	0	0	0	0	0
127	2005	0	0	0	0	0
130	2005	0	0	0	0	0
133	2005	0	0	0	0	0
135	2005	0	0	0	0	0
137	2005	0.00136	0	0	0	0
138	2005	0	0	0	0	0

Site	Year	*Cyperus* spp.	*Alternanthera philoxeroides*	*Paspalum fluitans*	*Myriophyllum spicatum*	*Hydrilla verticillata*
109	2005	0	0	0	0	0.00036
110	2005	0	0	0	0	0
111	2005	0	0	0	0	0.18404
112	2005	0	0	0	0	0.17524
113	2005	0.01006	0	0.01322	0	0.19936
114	2005	0	0	0	0	0.00888
115	2005	0	0	0	0	0.10714
116	2005	0	0	0	0	0
117	2005	0	0	0	0	0
118	2005	0	0	0	0	0
120	2005	0	0	0	0	0.06696
121	2005	0	0	0	0	0.0041
122	2005	0	0	0	0	0
123	2005	0	0	0	0	0
124	2005	0	0	0	0	0
125	2005	0	0	0	0	0
127	2005	0	0	0	0	0
130	2005	0	0	0	0	0
133	2005	0	0	0	0	0
135	2005	0	0	0	0	0
137	2005	0	0	0	0	0
138	2005	0	0	0	0	0
139	2005	0	0	0	0	0
140	2005	0	0	0	0	0
141	2005	0	0	0	0	0
142	2005	0	0	0	0	0

site	Year	*Nelumbo lutea*	*Cabomba caroliniana*	*Ceratophyllum demersum*	*Salvinia minima*	*Potamogeton* spp.
109	2005	0	0	0	0.2511	0
110	2005	0	0	0	0	0
111	2005	0	0	0	0.0126	0
112	2005	0	0	0	0.00094	0.03178
113	2005	0	0	0.00994	0.09834	0
114	2005	0	0	0.05712	0.21972	0
115	2005	0	0	0	0.02484	0
116	2005	0	0	0	0	0
117	2005	0	0	0	0	0
118	2005	0	0	0.03754	0.00312	0
120	2005	0	0	0.06098	0.03128	0
121	2005	0	0	0	0.69356	0
122	2005	0	0	0	0.0282	0
123	2005	0	0	0	0.44348	0
124	2005	0	0	0	0.09786	0
125	2005	0	0	0	0	0
127	2005	0	0	0	0	0
130	2005	0	0	0	0	0
133	2005	0	0	0	0	0
135	2005	0	0	0	1	0
137	2005	0	0	0.01156	0.06476	0
138	2005	0	0	0	0	0
139	2005	0	0	0	1	0
140	2005	0	0	0.05796	0.9296	0
141	2005	0	0	0	1	0
142	2005	0	0	0	0.0104	0

site	Year	*Ludwigia peploides*	*Utricularia vulgaris*	*Azolla caroliniana*	*Salvinia molesta*	*Najas guadalupensis*
109	2005	0.00834	0	.	.	.
110	2005	0	0	.	.	.
111	2005	0	0	.	.	.
112	2005	0	0	.	.	.
113	2005	0	0	.	.	.
114	2005	0	0	.	.	.
115	2005	0	0	.	.	.
116	2005	0	0	.	.	.
117	2005	0	0	.	.	.
118	2005	0	0	.	.	.
120	2005	0	0	.	.	.
121	2005	0	0	.	.	.
122	2005	0	0	.	.	.
123	2005	0	0	.	.	.
124	2005	0	0	.	.	.
125	2005	0	0	.	.	.
127	2005	0	0	.	.	.
130	2005	0	0	.	.	.
133	2005	0	0	.	.	.
135	2005	0	0	.	.	.
137	2005	0	0	.	.	.
138	2005	0	0	.	.	.
139	2005	0	0	.	.	.
140	2005	0	0	.	.	.
141	2005	0	0	.	.	.
142	2005	0	0	.	.	.

Site	Year	*Lemna* spp.	*Hydrocotyle ranunculoides*	*Spirodela polyrhiza*	*Eichhornia crassipes*	*Limnobium spongia*
139	2005	0	0	0	0	0
140	2005	0.0008	0	0	0	0
141	2005	0	0	0	0	0
142	2005	0	0	0	0	0
144	2005	0	0	0	0	0
158	2005	0	0	0	0	0
162	2005	0	0	0	0	0
164	2005	0	0	0	0	0
1	2006	0	0	0	0	0
2	2006	0	0	0	0	0
3	2006	0.00034	0	0.00056	0.03792	0
4	2006	0	0	0	0	0
5	2006	0.0008	0	0.0011	0.01366	0.00018
6	2006	0.00006	0	0	0	0
8	2006	0.00056	0	0.0005	0.03844	0
9	2006	0	0	0	0	0
10	2006	0.00038	0	0	0	0
11	2006	0.00018	0	0.00036	0	0
17	2006	0.00018	0	0.0006	0.0134	0
19	2006	0	0	0	0	0
20	2006	0	0	0	0	0
22	2006	0.00002	0	0.00002	0	0
23	2006	0.00002	0	0.00098	0.0146	0
25	2006	0.00002	0	0.00002	0	0
26	2006	0.00008	0	0.00094	0.00602	0
31	2006	0.0007	0	0.00116	0.00892	0

Site	Year	*Cyperus* spp.	*Alternanthera philoxeroides*	*Paspalum fluitans*	*Myriophyllum spicatum*	*Hydrilla verticillata*
144	2005	0	0	0	0	0
158	2005	0	0	0	0	0
162	2005	0	0	0	0	0
164	2005	0	0	0	0	0
1	2006	0	0	0	0	0
2	2006	0	0	0	0	0
3	2006	0	0	0	0	0
4	2006	0	0	0	0.00878	0
5	2006	0	0.0007	0	0	0
6	2006	0	0	0	0	0
8	2006	0	0.00602	0	0	0
9	2006	0	0	0	0	0
10	2006	0	0	0	0	0
11	2006	0	0	0	0	0
17	2006	0	0	0	0	0
19	2006	0	0	0	0	0
20	2006	0	0	0	0	0
22	2006	0	0	0	0	0
23	2006	0.00406	0	0	0	0.00012
25	2006	0	0	0	0	0
26	2006	0	0.00372	0	0	0
31	2006	0	0	0	0	0
35	2006	0	0	0	0	0
37	2006	0	0	0	0	0
43	2006	0.00008	0.00018	0	0	0
44	2006	0	0.00084	0	0	0

site	Year	*Nelumbo lutea*	*Cabomba caroliniana*	*Ceratophyllum demersum*	*Salvinia minima*	*Potamogeton* spp.
144	2005	0	0	0	0.00066	0
158	2005	0	0	0	0	0
162	2005	0	0	0	0	0
164	2005	0	0	0	0	0
1	2006	0	0	0	0	0
2	2006	0	0	0	0	0
3	2006	0	0	0	0.02478	0
4	2006	0	0	0	0	0
5	2006	0	0	0	0.10454	0
6	2006	0	0	0	0.00334	0
8	2006	0	0	0	0.02494	0.03662
9	2006	0	0	0	0	0
10	2006	0	0	0	0.00554	0
11	2006	0	0	0	0.02212	0
17	2006	0	0	0	0.18204	0
19	2006	0	0	0	0	0
20	2006	0	0	0	0	0
22	2006	0	0	0	0.0026	0
23	2006	0	0	0.00004	0.09476	0
25	2006	0	0	0	0.0061	0
26	2006	0	0	0	0.09994	0
31	2006	0	0.14642	0.00044	0.19542	0
35	2006	0	0	0	0.17762	0
37	2006	0	0	0	0.0507	0
43	2006	0	0	0.00584	0.25242	0
44	2006	0	0	0.00398	0.00488	0

site	Year	*Ludwigia peploides*	*Utricularia vulgaris*	*Azolla caroliniana*	*Salvinia molesta*	*Najas guadalupensis*
144	2005	0	0	.	.	.
158	2005	0	0	.	.	.
162	2005	0	0	.	.	.
164	2005	0	0	.	.	.
1	2006	0	0	0	0	0
2	2006	0	0	0	0	0
3	2006	0	0	0	0	0
4	2006	0	0	0	0	0
5	2006	0	0	0	0	0
6	2006	0	0	0	0	0
8	2006	0	0	0	0	0
9	2006	0	0	0	0	0
10	2006	0	0	0	0	0
11	2006	0	0	0	0	0
17	2006	0	0	0	0	0
19	2006	0	0	0	0	0
20	2006	0	0	0	0	0
22	2006	0	0	0	0	0
23	2006	0	0.00366	0	0	0
25	2006	0	0	0	0	0
26	2006	0	0	0	0	0
31	2006	0	0	0	0	0
35	2006	0	0	0	0	0
37	2006	0	0	0	0	0
43	2006	0	0	0	0.00654	0
44	2006	0	0	0	0	0

Site	Year	*Lemna* spp.	*Hydrocotyle ranunculoides*	*Spirodela polyrhiza*	*Eichhornia crassipes*	*Limnobium spongia*
35	2006	0.00012	0	0.00036	0.00978	0
37	2006	0.00054	0	0.00046	0.06152	0
43	2006	0.00092	0	0.00066	0.14296	0
44	2006	0.00006	0	0	0.0016	0
45	2006	0.00136	0	0.00818	0.07534	0.00056
46	2006	0.00248	0	0.00074	0.09102	0
47	2006	0.00096	0	0.00058	0.05428	0
48	2006	0.00036	0	0	0.00858	0.00064
50	2006	0.00164	0	0.0009	0.05162	0
51	2006	0.0011	0.02486	0.00038	0.0212	0.00662
52	2006	0.00074	0	0.0014	0.10166	0
55	2006	0.00182	0	0.00166	0.05904	0.00034
56	2006	0.00178	0	0.00114	0.02694	0.00042
63	2006	0	0	0	0	0
64	2006	0.00072	0	0.00052	0.09922	0
65	2006	0	0	0	0	0
66	2006	0	0	0	0	0
67	2006	0.00266	0	0.00604	0.11458	0.00092
68	2006	0.00028	0	0.0022	0.03098	0
69	2006	0	0	0	0	0
70	2006	0.00526	0	0.0003	0.040016	0
71	2006	0.00026	0	0.00066	0.0106	0
72	2006	0	0	0	0	0
73	2006	0.00016	0	0.0002	0.00546	0.00024
74	2006	0.00014	0	0	0	0
75	2006	0.0006	0	0.00138	0.02318	0

Site	Year	*Cyperus* spp.	*Alternanthera philoxeroides*	*Paspalum fluitans*	*Myriophyllum spicatum*	*Hydrilla verticillata*
45	2006	0.00634	0	0	0	0
46	2006	0.0004	0.00234	0.00942	0	0.00048
47	2006	0	0	0	0	0
48	2006	0	0	0	0	0.01304
50	2006	0.00104	0.00476	0.02152	0	0
51	2006	0.00034	0.1392	0	0	0
52	2006	0.03116	0.01028	0	0	0
55	2006	0.00118	0	0	0	0.116
56	2006	0	0.02478	0.0274	0	0
63	2006	0	0	0	0	0
64	2006	0	0	0	0	0
65	2006	0	0	0	0	0
66	2006	0	0	0	0	0
67	2006	0.05426	0.00308	0	0	0
68	2006	0.06006	0	0	0	0
69	2006	0	0	0	0	0
70	2006	0	0.01988	0	0	0
71	2006	0	0	0	0	0
72	2006	0	0	0	0	0
73	2006	0	0	0	0	0
74	2006	0	0	0	0	0
75	2006	0	0.00976	0.0665	0	0
76	2006	0	0	0.00996	0	0
78	2006	0.01076	0.01856	0.0038	0	0
79	2006	0	0.00244	0.00612	0	0
80	2006	0.01228	0	0.0301	0	0

site	Year	*Nelumbo lutea*	*Cabomba caroliniana*	*Ceratophyllum demersum*	*Salvinia minima*	*Potamogeton* spp.
45	2006	0	0	0.00336	0.2469	0
46	2006	0	0	0.00188	0.1542	0
47	2006	0	0	0	0.13768	0
48	2006	0	0	0	0.01158	0
50	2006	0	0.00122	0	0.22372	0
51	2006	0	0.00146	0.0403	0.20684	0
52	2006	0	0	0	0.17372	0
55	2006	0	0.0024	0.00722	0.15082	0
56	2006	0	0	0	0.30956	0
63	2006	0	0	0	0	0
64	2006	0	0	0	0.07732	0
65	2006	0	0	0	0	0
66	2006	0	0	0	0	0
67	2006	0	0.00846	0.00454	0.4032	0
68	2006	0	0	0	0.10548	0
69	2006	0	0	0	0	0
70	2006	0	0	0	0.19626	0
71	2006	0	0	0	0.02368	0
72	2006	0	0	0	0	0
73	2006	0	0	0.00556	0.02992	0
74	2006	0	0	0	0.00484	0
75	2006	0	0	0	0.16938	0
76	2006	0	0	0	0.94508	0
78	2006	0	0	0	0.21668	0
79	2006	0	0	0	0.87626	0
80	2006	0	0	0.00122	0.122	0

site	Year	*Ludwigia peploides*	*Utricularia vulgaris*	*Azolla caroliniana*	*Salvinia molesta*	*Najas guadalupensis*
45	2006	0	0	0	0	0
46	2006	0	0	0	0	0
47	2006	0	0	0	0	0
48	2006	0	0	0	0	0
50	2006	0.04958	0	0	0	0.00122
51	2006	0	0	0	0.0031	0
52	2006	0	0	0	0	0
55	2006	0	0	0	0	0
56	2006	0.00736	0	0	0.00068	0
63	2006	0	0	0	0	0
64	2006	0	0	0	0	0
65	2006	0	0	0	0	0
66	2006	0	0	0	0	0
67	2006	0	0	0	0	0
68	2006	0	0	0	0	0
69	2006	0	0	0	0	0
70	2006	0	0	0	0	0
71	2006	0	0	0	0.00354	0
72	2006	0	0	0	0	0
73	2006	0	0	0	0	0.02818
74	2006	0	0	0	0	0
75	2006	0	0	0	0	0
76	2006	0	0	0	0	0
78	2006	0	0	0	0	0
79	2006	0	0	0	0	0
80	2006	0	0	0	0	0

Site	Year	*Lemna* spp.	*Hydrocotyle ranunculoides*	*Spirodela polyrhiza*	*Eichhornia crassipes*	*Limnobium spongia*
76	2006	0.00322	0	0.0049	0.03684	0
78	2006	0.0019	0	0.00152	0.00602	0
79	2006	0.00214	0	0.00598	0.10706	0
80	2006	0.00058	0	0.00126	0.14574	0
82	2006	0.00312	0	0.0057	0.14946	0
83	2006	0.0038	0	0.00522	0.07616	0
84	2006	0.00244	0	0.00226	0	0
85	2006	0.00208	0	0.00026	0.01944	0
86	2006	0.001	0	0.00148	0	0
87	2006	0	0	0.00006	0	0
88	2006	0.00014	0	0	0	0
89	2006	0.00124	0	0.00052	0	0
90	2006	0.00206	0	0.00048	0	0.00086
91	2006	0.00154	0	0.00032	0	0
92	2006	0.00746	0	0.00228	0.00458	0
93	2006	0.00388	0	0.00228	0	0.00104
94	2006	0	0	0	0	0
95	2006	0.00182	0	0.00084	0.11102	0
96	2006	0	0	0	0	0
97	2006	0.00398	0	0.0003	0.0179	0
98	2006	0.00094	0	0.00048	0.00386	0
99	2006	0	0	0	0	0
100	2006	0.00012	0	0	0	0
101	2006	0.00078	0	0.00032	0.00682	0
102	2006	0.00044	0	0.00008	0	0
103	2006	0.00046	0	0.00034	0.09336	0

Site	Year	*Cyperus* spp.	*Alternanthera philoxeroides*	*Paspalum fluitans*	*Myriophyllum spicatum*	*Hydrilla verticillata*
81	2006	0	0	0.03638	0	0
82	2006	0.0051	0	0.0084	0	0
83	2006	0	0.01574	0.0088	0	0.00462
84	2006	0	0	0.006	0	0
85	2006	0	0	0	0	0
86	2006	0	0	0	0	0.00768
87	2006	0	0	0	0	0
88	2006	0	0	0	0	0.01156
89	2006	0	0	0	0	0.00286
90	2006	0	0	0	0	0
91	2006	0	0	0.00814	0	0.00078
92	2006	0	0	0.02988	0	0
93	2006	0	0	0	0	0.0047
94	2006	0	0	0	0	0
95	2006	0	0	0.07858	0	0.00688
96	2006	0	0	0	0	0
97	2006	0.0047	0	0.01988	0	0
98	2006	0	0	0.03714	0	0.03404
99	2006	0	0	0	0	0
100	2006	0	0	0	0	0
101	2006	0	0	0.01404	0	0
102	2006	0	0	0.06196	0	0
103	2006	0	0	0	0	0.01174
104	2006	0	0	0	0	0.00162
105	2006	0	0	0	0	0
106	2006	0	0	0	0	0.00148

site	Year	*Nelumbo lutea*	*Cabomba caroliniana*	*Ceratophyllum demersum*	*Salvinia minima*	*Potamogeton* spp.
81	2006	0	0	0	0.14188	0
82	2006	0	0	0	0.33238	0
83	2006	0	0	0	0.198	0
84	2006	0	0	0.0018	0.7041	0
85	2006	0	0	0	0.11272	0
86	2006	0	0	0.00356	0.1247	0
87	2006	0	0	0	0.00062	0
88	2006	0	0	0	0.02006	0
89	2006	0	0	0.0042	0.07366	0
90	2006	0	0	0.00364	0.2949	0
91	2006	0	0	0	0.12348	0
92	2006	0	0	0.01454	0	0
93	2006	0	0	0.02632	0.12902	0
94	2006	0	0	0	0	0
95	2006	0	0.00344	0.0031	0.45192	0
96	2006	0	0	0	0	0
97	2006	0	0	0	0.90318	0
98	2006	0	0	0	0.381	0
99	2006	0	0	0	0	0
100	2006	0	0	0	0.0731	0
101	2006	0	0	0	0.21204	0
102	2006	0	0	0.00588	0.03768	0
103	2006	0	0	0.00218	0.09188	0
104	2006	0	0	0	0.15204	0
105	2006	0	0	0	0	0
106	2006	0	0	0.01848	0.09026	0

site	Year	*Ludwigia peploides*	*Utricularia vulgaris*	*Azolla caroliniana*	*Salvinia molesta*	*Najas guadalupensis*
81	2006	0	0	0	0	0
82	2006	0	0	0	0	0
83	2006	0	0	0	0	0
84	2006	0.03128	0	0	0	0
85	2006	0	0	0	0	0
86	2006	0	0	0	0	0
87	2006	0	0	0	0	0
88	2006	0	0	0	0	0
89	2006	0	0	0	0	0
90	2006	0	0	0	0	0
91	2006	0.00366	0	0	0	0
92	2006	0	0	0	0	0
93	2006	0	0	0	0	0
94	2006	0	0	0	0	0
95	2006	0	0	0	0	0
96	2006	0	0	0	0	0
97	2006	0	0	0	0	0
98	2006	0	0	0	0	0
99	2006	0	0	0	0	0
100	2006	0	0	0	0	0
101	2006	0	0	0	0	0
102	2006	0	0	0	0	0
103	2006	0.02506	0	0	0	0
104	2006	0	0	0	0	0
105	2006	0	0	0	0	0
106	2006	0	0	0	0	0

Site	Year	*Lemna* spp.	*Hydrocotyle ranunculoides*	*Spirodela polyrhiza*	*Eichhornia crassipes*	*Limnobium spongia*
104	2006	0.00034	0	0	0	0.00232
105	2006	0	0	0	0	0
106	2006	0.001	0	0.00016	0	0
107	2006	0.00768	0	0.00068	0	0
108	2006	0.00008	0	0	0	0
109	2006	0.0003	0	0	0	0
110	2006	0	0	0	0	0
111	2006	0.00138	0	0.00022	0	0
112	2006	0.0021	0	0.00044	0	0
113	2006	0.0009	0	0.00004	0.04468	0
114	2006	0.00072	0	0.00114	0	0.0006
115	2006	0	0	0	0	0
116	2006	0	0	0	0	0
117	2006	0.00104	0	0.00014	0	0
118	2006	0.00126	0	0.00008	0	0
120	2006	0.00088	0	0.00026	0	0.00428
121	2006	0.00326	0	0.00044	0	0
122	2006	0.00528	0	0.00114	0	0.00664
123	2006	0.01614	0	0.00108	0	0.00294
124	2006	0.0002	0	0.00024	0	0
125	2006	0	0	0	0	0
127	2006	0	0	0	0	0
130	2006	0	0	0	0	0
133	2006	0	0	0	0	0
135	2006	0	0	0	0	0
137	2006	0.00002	0	0	0	0

Site	Year	*Cyperus* spp.	*Alternanthera philoxeroides*	*Paspalum fluitans*	*Myriophyllum spicatum*	*Hydrilla verticillata*
107	2006	0	0	0	0	0
108	2006	0	0	0	0	0
109	2006	0	0	0	0	0.00358
110	2006	0	0	0	0	0
111	2006	0	0	0	0	0.001
112	2006	0	0	0.01318	0	0
113	2006	0	0.00192	0.00358	0	0
114	2006	0	0	0	0	0.01416
115	2006	0	0	0	0	0
116	2006	0	0	0	0	0
117	2006	0	0	0	0	0
118	2006	0	0	0	0	0.00666
120	2006	0	0	0	0	0
121	2006	0	0	0.07522	0	0.03526
122	2006	0	0	0	0	0.07352
123	2006	0	0	0	0	0
124	2006	0	0	0	0	0.00066
125	2006	0	0	0	0	0
127	2006	0	0	0	0	0
130	2006	0	0	0	0	0
133	2006	0	0	0	0	0
135	2006	0	0	0	0	0
137	2006	0	0	0	0	0
138	2006	0	0	0	0	0
139	2006	0	0	0	0	0
140	2006	0	0	0	0	0

site	Year	*Nelumbo lutea*	*Cabomba caroliniana*	*Ceratophyllum demersum*	*Salvinia minima*	*Potamogeton* spp.
107	2006	0	0	0	0.45784	0
108	2006	0	0	0	0.00064	0.00434
109	2006	0	0	0.0102	0.044	0
110	2006	0	0	0	0	0
111	2006	0.0668	0	0.00862	0.01264	0
112	2006	0	0	0	0.14602	0
113	2006	0	0	0	0.94444	0
114	2006	0	0	0.00832	0.24666	0
115	2006	0	0	0	0	0
116	2006	0	0	0	0	0
117	2006	0	0	0	0.10716	0
118	2006	0	0	0	0.04148	0.0044
120	2006	0	0	0	0.99458	0
121	2006	0	0	0	0.86278	0
122	2006	0	0	0.07714	0.04318	0
123	2006	0	0	0	0.10954	0
124	2006	0	0	0.00642	0.01482	0
125	2006	0	0	0	0	0
127	2006	0	0	0	0	0
130	2006	0	0	0	0	0
133	2006	0	0	0	0	0
135	2006	0	0	0	0.04866	0
137	2006	0	0	0	0.0378	0
138	2006	0	0	0	0	0
139	2006	0	0.01126	0	0.9767	0
140	2006	0	0	0	1	0

site	Year	*Ludwigia peploides*	*Utricularia vulgaris*	*Azolla caroliniana*	*Salvinia molesta*	*Najas guadalupensis*
107	2006	0.03028	0	0.00008	0	0
108	2006	0	0	0	0	0
109	2006	0	0	0	0	0
110	2006	0	0	0	0	0
111	2006	0	0	0	0	0
112	2006	0	0	0	0	0
113	2006	0	0	0	0	0
114	2006	0	0	0	0	0
115	2006	0	0	0	0	0
116	2006	0	0	0	0	0
117	2006	0	0	0	0	0
118	2006	0	0	0	0	0.33898
120	2006	0	0	0	0	0
121	2006	0	0	0	0	0
122	2006	0	0	0.00024	0	0
123	2006	0	0	0.00022	0	0
124	2006	0	0	0.00004	0	0
125	2006	0	0	0	0	0
127	2006	0	0	0	0	0
130	2006	0	0	0	0	0
133	2006	0	0	0	0	0
135	2006	0	0	0	0	0
137	2006	0	0	0	0	0
138	2006	0	0	0	0	0
139	2006	0	0	0	0	0
140	2006	0	0	0	0	0

Site	Year	*Lemna* spp.	*Hydrocotyle ranunculoides*	*Spirodela polyrhiza*	*Eichhornia crassipes*	*Limnobium spongia*
138	2006	0	0	0	0	0
139	2006	0	0	0	0	0
140	2006	0	0.01204	0	0	0
141	2006	0.00304	0	0.00012	0	0
142	2006	0	0	0.0001	0	0
144	2006	0	0	0	0	0

Site	Year	*Cyperus* spp.	*Alternanthera philoxeroides*	*Paspalum fluitans*	*M. spicatum*	*Hydrilla verticillata*
141	2006	0	0	0	0	0.00512
142	2006	0	0	0	0	0
144	2006	0	0	0	0	0

Site	Year	*N. lutea*	*Cabomba caroliniana*	*C. demersum*	*Salvinia minima*	*Potamogeton* spp.
141	2006	0	0	0.00092	0.1445	0
142	2006	0	0	0	0.0014	0
144	2006	0	0	0	0	0

Site	Year	*L. peploides*	*Utricularia vulgaris*	*Azolla caroliniana*	*Salvinia molesta*	*Najas guadalupensis*
141	2006	0	0	0	0	0
142	2006	0	0	0	0	0
144	2006	0	0	0	0	0

APPENDIX D: DRY WEIGHTS OF SAMPLED PLANTS

Site	*Lemna* spp.	*Hydrocotyle ranunculoides*	*Spirodela polyrhiza*	*Eichhornia crassipes*	*Limnobium spongia*
4	0	0	0	0	0
8	0.0018	0	0	0	0
11	0.171	0	0.1423	12.4747	0
23	0.0418	0	0.0791	4.7213	0
48	0.0001	0	0	0.8898	0.3103
51	0	4.0295	0	3.0524	0.117
52	0	0	0	23.9828	0
55	0.0471	0	0.0016	0	0.0143
55	0	0	0	0	0
64	0.0234	0	0.0557	51.4729	0
68	0.1671	0	0.1456	9.597	0
71	0.0001	0	0.0001	0.5084	0
71	0.0025	0	0.0033	1.798	0
75	0.0001	0	0.004	0.6677	0
82	0.0138	0	0.0144	0	0
83	0.0391	0	0.0465	7.553	0
93	0.001	0	0.0552	0	0.1643
102	0.0216	0	0.0189	0	0
107	0.0392	0	0.0266	0	0
111	0	0	0	0	0
118	0.0218	0	0.015	0	0
120	0	0	0	0	0
121	0.1165	0	0.0169	0	0
122	0.0582	0	0.0099	0	0.0377
123	0.7104	0	0.0155	0	0.1566

Site	*Cyperus* spp.	*Alternathera philoxeroides*	*Paspalum fluitans*	*Myriophyllum spicatum*	*Salvinia minima*
4	0	0	0	0.7825	0
8	0	0	0	0	0.2275
11	0	0	0	0	1.2788
23	2.7916	0	0	0	6.5432
48	0	0	0	0	0.5979
51	0	2.5601	0	0	0
52	6.2938	1.3797	0	0	0
55	0	0.7206	0	0	2.7537
55	0	0	0	0	0
64	0	0	0	0	5.4546
68	21.9146	0	0	0	7.6598
71	0	0	0	0	0.143
71	0	0	0	0	1.2843
75	0	0	4.3711	0	5.2035
82	4.2713	0	0	0	4.2319
83	0	2.8251	0	0	11.0254
93	0	0	0	0	4.2368
102	0	0	3.5417	0	0.2025
107	0	0	0	0	10.0017
111	0	0	0	0	0.0952
118	0	0	0	0	2.4348
120	0	0	0	0	40.6188
121	0	0	0.0933	0	30.8613
122	0	0	0	0	1.0833
123	0	0	0	0	5.7837

Site	*Nelumbo lutea*	*Cabomba caroliniana*	*Hydrilla verticillata*	*Ceratophyllum demersum*	*Potamogeton* spp.
4	0	0	0	0	0
8	0	0	0	0	5.2278
11	0	0	0	0.207	0
23	0	0	2.8063	0.3579	0
48	0	0	0.0098	0	0
51	0	0	0	0	0
52	0	0	0	0	0
55	0	0.7134	0	1.1724	0
55	0	0	36.1647	0	0
64	0	0	0	0	0
68	0	0	0	0.082	0
71	0	0	0	0	0
71	0	0	0	0	0
75	0	0	0	0	0
82	0	0	0	0	0
83	0	0	10.8001	0.0179	0
93	0	0	0	0.9055	0
102	0	0	0	0.9576	0
107	0	0	4.8892	0.2093	0
111	5.2233	0	0.1865	0	0
118	0	0	0	0	0
120	0	0	0	0	0
121	0	0	2.0254	0	0
122	0	0	9.392	4.8456	0
123	0	0	0	0	0

Site	*Ludwigia peploides*	*Utricularia vulgaris*	*Azolla caroliniana*	*Salvinia molesta*	*Najas guadalupensis*
4	0	0	0	0	0
8	0	0	0	0	0
11	0	0	0	0	0
23	0	0.2613	0	0	0
48	0	0	0	0	0
51	0	0	0	0.1017	0
52	0	0	0	0	0
55	0	0	0	0	0.1806
55	0	0	0	0	0
64	0	0	0	0	0
68	0	0	0	0	0
71	0	0	0	0.1456	0
71	0	0	0.0017	0.0756	0
75	0	0	0	0	0
82	0	0	0	0	0
83	0	0	0	0	0
93	0	0	0	0	0
102	0	0	0	0	0
107	10.0954	0	0	0	0
111	0	0	0	0	0
118	0	0	0	0	35.2008
120	0	0	0	0	0
121	0	0	0	0	0
122	0	0	0.0001	0	0
123	0	0	0.0077	0	0

VITA

Rachel Walley grew up in Oklahoma where she graduated from Glenpool High School in 1997. Rachel, then, briefly attended Tulsa Community College in Tulsa, Oklahoma, before transferring to Baton Rouge, Louisiana, in 1998. Rachel completed her undergraduate education at Louisiana State University, where she majored in wildlife and fisheries conservation. In 2004, Rachel received a Bachelor of Science in agriculture from the School of Renewable Natural Resources. She then continued at Louisiana State University to work on a Master of Science degree in fisheries. Rachel's future plans are to continue research of aquatic plants in wetland systems.